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Coastal Area Management Education in the ASEAN Region

Edited by
Chua Thia-Eng

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Proceedings of the Workshop on Coastal Area Management
Education in the ASEAN Region
Singapore
8-11 October 1990

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ICLARM



**Association of Southeast Asian Nations/United States
Coastal Resources Management Project
Conference Proceedings 8**

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List of Acronyms and Abbreviations

ASEAN/US CRMP	Association of Southeast Asian Nations/United States Coastal Resources Management Project
BASE	Brunei Association for Science Education
BAU	Bogor Agricultural University
BFAR	Bureau of Fisheries and Aquatic Resources
B.S.	Bachelor of Science
CAM	coastal area management
CAMP	Coastal Area Management Program
CCD	Coast Conservation Department
CORIN	Coastal Resources Institute
CRM	coastal resources management
CRMC	Coastal Resources Management Council
CZM	coastal zone management
CZMP	Coastal Zone Management Program
DECS	Department of Education, Culture and Sports
EIA	environmental impact assessment
EIS	environmental information system
EISS	Environmental Impact Statement System
ERDAS	Earth Resources Data Analysis System
ESPOL	Escuela Superior Politécnica del Litoral
FIT	Florida Institute of Technology
GIS	geographic information system
ICLARM	International Center for Living Aquatic Resources Management
LL.M.	Master of Laws
M.A.M.A.	Master of Arts in Marine Affairs
MICROBRIAN	Micro Barrier Reef Image Analysis
M.M.A.	Master in Marine Affairs
MOE	Ministry of Education
M.S.	Master of Science
MSU	Mindanao State University
NUS	National University of Singapore
PD	Presidential Decree
PERT-CPM	Program Evaluation and Review Technique-Critical Path Method

Ph.D.	Doctor of Philosophy
PSU	Prince of Songkla University
RA	Republic Act
REPELITA IV	IVth Five-year Development Plan
SBEM	School of Building and Estate Management
SPANS	Spatial Analysis System
SPOT	Satellite Probatoire pour l'Observation de la Terre
SU	Silliman University
UBD	Universiti Brunei Darussalam
UK	United Kingdom
UKM	Universiti Kebangsaan Malaysia
UM	Universiti Malaya
	University of Massachusetts
UNDIP	Diponegoro University
UNT	University of Newcastle upon Tyne
UPCE	University of the Philippines College of Engineering
UPIS	University of the Philippines Integrated School
UPLB-IESAM	University of the Philippines at Los Baños- Institute of Environmental Science Management
UPLC	University of the Philippines Law Center
UPMSI	University of the Philippines Marine Science Institute
UPM	Universiti Pertanian Malaysia
UPSURP	University of the Philippines School of Urban and Regional Planning
URI	University of Rhode Island
USAID	United States Agency for International Development
USM	Universiti Sains Malaysia
UTM	Universiti Teknologi Malaysia
UW	University of Washington

Preface

The coastal waters of Southeast Asian countries have some of the world's richest ecosystems and habitats characterized by extensive coral reefs and dense mangrove forests. Blessed with warm tropical climate and high rainfall, these waters are further enriched with nutrients from the land which enable them to support a wide diversity of marine life. Because economic benefits could be derived from them, the coastal zones in these countries teem with human settlements. Over 70% of the population in the region lives in coastal areas where resources have been heavily exploited. This situation became apparent between the 1960s and 1970s when socioeconomic pressures increased. Large-scale destruction of the region's valuable resources has caused serious degradation of the environment, thus affecting the economic life of the coastal inhabitants. This lamentable situation is mainly the result of ineffective or poor management of the coastal resources.

Coastal resources are valuable assets that should be utilized on a sustainable basis. Unisectoral overuse of some resources has caused grave problems. Indiscriminate logging and mining in upland areas might have brought large economic benefits to companies undertaking these activities and, to a certain extent, increased government revenues, but could prove detrimental to lowland activities such as fisheries, aquaculture and coastal tourism-dependent industries. Similarly, unregulated fishing effort and the use of destructive fishing methods, such as mechanized push-nets and dynamiting, have seriously destroyed fish habitats and reduced fish stocks. Indiscriminate cutting of mangroves for aquaculture, fuel wood, timber and the like has brought temporary gains in fish production, fuel wood and timber supply but losses in nursery areas of commercially important fish and shrimp, coastal erosion and land accretion.

The coastal zones of most nations in the Association of Southeast Asian Nations (ASEAN) are subjected to increasing population and economic pressures manifested by a variety of coastal activities, notably, fishing, coastal aquaculture, waste disposal, salt-making, tin mining, oil drilling, tanker traffic, rural construction and industrialization. This situation is aggravated by the expanding economic activities attempting to uplift the standard of living of coastal people, the majority of whom live below the official poverty line.

Introduction

The continuing efforts of ASEAN countries to develop and implement their coastal area management (CAM) programs and to sustain smooth program operation for the long term have created the demand for coastal area planners and managers and related professional and technical staff. The urgent need for formal education and training to produce this new breed of experts was addressed by the Workshop on Coastal Area Management Education in the ASEAN Region. Workshop sessions followed closely the attainment of these objectives:

1. to provide guidelines for incorporating coastal area planning and management as new academic study areas in educational programs in higher institutions in the ASEAN region;
2. to develop a regional master's degree course curricula for the study areas;
3. to explore the feasibility of executing such a graduate level program through a joint regional effort or consortium of universities; and
4. to explore collaborative efforts in preparing instructional materials for the CAM postgraduate program.

To serve the needs for CAM education in the ASEAN region, the following options were considered: (1) individual national programs, (2) one or more national institutions working independently, (3) a network of several national institutions and (4) an existing regional institution.

Contributed papers summarized the present capabilities and constraints of educational institutions in the region vis-à-vis a graduate degree course on CAM, which is not currently offered in any ASEAN university. It was recommended that the comparative advantages of these academic institutions to implement such a program be evaluated. Appropriate teaching materials, with special emphasis on case studies, should be developed.

Conducting a national and regional survey to assess: (1) the current and projected demand for CAM education and (2) the availability of, versus demand for, trained personnel who could also serve as instructors, would prove useful.

The consensus of workshop participants after deliberations was that CAM education should produce generalists (rather than specialists), with a wholistic perspective who will act as resource managers.

As pointed out in *Year 2000: challenges for marine science teaching and education worldwide* (UNESCO Mar. Sci. Rep. 52, 1988), the complex inter- and multidisciplinary scientific CAM problems must be addressed, as well as coastal engineering options for solving these problems. There is a need to encourage greater awareness of the social, cultural, political, economic and other aspects of CAM.

At the conclusion of the workshop, ICLARM was called upon to play a lead role in technical assistance and coordination of follow-up activities. Given the international validity of the proposed curriculum and the need for the broadest possible base to implement it, international organizations such as the United Nations Educational, Scientific and Cultural Organization and the Food and Agriculture Organization, aside from key national and regional institutions, were relied on for continued technical and financial support.

It is hoped that this regional meeting will benefit the ASEAN region and stimulate the holding of national workshops in the future to strengthen human resources capability in CAM.

Part I: Status of Environmental Science Education

Environmental Science Education in Brunei Darussalam with Special Reference to Coastal Management

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Abstract

Environmental education is not a recognized academic discipline in Brunei Darussalam schools, but its increasing importance as an area of study is becoming evident. Due to the country's growing concern on the environment, science education is undergoing evaluation to improve facilities, expand the scope of subjects and upgrade syllabi. Various institutions conduct research on environmental problems and the ecology of coastal ecosystems. One of these institutions is the Universiti Brunei Darussalam (UBD).

Introduction

All citizens of Brunei Darussalam have the privilege of free education, from kindergarten to university level. Since the establishment of the first school in 1912 (which had 53 students), the number of schools has increased steadily to a total of 176 in 1989 (with an enrollment of 65,493

and a teaching staff of 4,283). Of these, 132 are government schools (116 primary, 16 secondary) and 44 are private schools. Postsecondary institutes include technical, nursing and agricultural colleges and a university. Malay and English are the media of instruction.

Education

Primary education

Environmental education is not a recognized academic discipline. However, it is increasingly becoming valued as an area of study as reflected in the following aims and objectives of the Ministry of Education's (MOE) present science education syllabus:

- to provide basic knowledge for children to appreciate living things and other natural resources;
- to develop their skills in observation, investigation and systematic thinking;
- to gather useful information about their own environment and cultivate awareness and appreciation of it; and
- to develop good values of hygiene and to enable them to recognize various aspects of sound health.

In lower primary level (primary 1 to 3, excluding a one-year preschool period), Science is integrated with Geography and History in General Studies. In upper primary level (primary 4 to 6), Science is taught as a separate subject in two 30-minute periods each week. Pupils are familiarized with basic scientific facts and principles, including certain environmental aspects and health issues. At the end of primary 6, a public examination (Primary Certificate of Education) is given, with Science included in General Studies.

Secondary education

In lower secondary level (forms 1 to 3), Science is compulsory. Four out of 40 periods per week are allocated to it. In most schools, it is under Integrated Science. Relevant topics include living things, energy, matter, gases, heat transfer, water and other solvents, earth and its resources and freshwater biology.

In upper secondary level (forms 4 to 6), Science is based on the 'O' and 'A' Level Examination Syllabus of the Local Examinations Syndicate of the University of Cambridge. At the 'A' level or Arts stream classes, Integrated Science, General Science, Combined Science, and Human and Social Biology are offered as optional subjects, but no science paper is given. Science stream or 'O' level students take pure science--Biology, Chemistry and Physics. Environmental issues and problems such as ero-

sion, pollution and environmental degradation are included in the Geography syllabus of both levels.

The country is increasingly becoming concerned about environmental problems. In this context, several secondary science teachers and education officers are being sent to different training programs. One was the 1988 Regional Training Course on Environmental Education organized by the United Nations Educational, Scientific and Cultural Organization Office for Asia and the Pacific. As a follow-up, a National Training Program in Environmental Education was coorganized and conducted by the MOE and UBD in 1989. Similar programs for other levels are planned for the future.

A committee under the chairmanship of the Director of School Inspectorate was set up in late 1987 to evaluate the teaching of science subjects in the country, come up with viable programs of action to encourage students and improve the teaching facilities. Proposals to incorporate more topics on environmental aspects at all levels have been forwarded. Some new syllabi are being prepared and will hopefully be implemented in the future.

The Brunei Association for Science Education (BASE), a member of the International Council of Associations for Science Education, organizes science camps during school vacations where students conduct ecological field studies and are introduced to the concepts of environmental resources management and conservation. BASE also organizes science exhibitions and competitions for secondary school students.

Postsecondary education

The Sinaut Agricultural Training Centre provides environment-related courses relevant to agriculture. Different departments of UBD also offer such courses (see Table 1). Courses of direct relevance to coastal area management (CAM) include: Ecology (involving an intensive two-week field course on ecosystems such as mangroves, and sandy, muddy and rocky shores), Living Resources, Environmental Systems, Economic Policy and National Development, Environmental Policy, Land Administration, Resource Studies, Urban Development, Environmental Chemistry, Geography of Resources, Geography of Development and Settlement Geography.

Coastal Area Research

Some staff of UBD have directed their research efforts to environmental problems. The Biology Department is currently carrying out detailed ecological studies of the different coastal ecosystems and offshore islands. Recently, it submitted two research studies to the National

Table 1. Undergraduate environment-related courses currently offered at UBD.

Faculty of Arts and Social Sciences	Faculty of Management and Administrative Studies (continued)
Department of Economics	Department of Management Studies
Economics of Public Sector	Introduction to Management and Organizations
Introduction to Economic Development	Management Information Systems
Economy of Brunei Darussalam	
Resource Economics	Faculty of Science
Agriculture Economics	
Department of Geography	Department of Biology
Introduction to Geography	Organisms and their Environment
Environmental Systems	Microorganisms and Lower Plants
Economic and Social Geography	Seed Plants
Human Geography with emphasis on Brunei Darussalam	Invertebrates
Population and Settlement Geography	Chordates
Map Reading and Cartography	Ecology
Regional Geography: Southeast Asia and Asia Pacific Basin	Ecology Field Courses
Quantitative Methods in Geography	Laboratory Techniques
Fieldwork in Geography	Animal Form and Function
Geomorphology and Climatology	Animal Physiology
Geography of Resources	Animal Behavior
Geography of Development	Plant Physiology
Economic Geography	Evolution and Population Genetics
Regional Geography and Development	Living Resources of Brunei Darussalam
Urban Geography	Biotechnology
Industrial Geography	Biometry
Biogeography and Soil	Aquatic Biology
Faculty of Management and Administrative Studies	Department of Chemistry
	Inorganic Chemistry
	Organic Chemistry
	Analytical Chemistry
Department of Public Policy and Administration	Industrial and Environmental Chemistry
ASEAN Country Studies	
ASEAN International Relations	
ASEAN Social and Political Issues	
Decentralization and Local Administration	
Development Administration	
Economic Policy and National Development	
Environmental Policy	
Land Administration	
Research Methods	
Resource Studies	
Social Policy and Planning	
Urban Development: Issues and Policies	
Urban Planning: Case Studies	

Steering Committee of the Brunei Darussalam component of the Association of Southeast Asian Nations/United States Coastal Resources Management Project (ASEAN/US CRMP): "Proposal for protected areas in coastal zones (including offshore islands)" and "Coastal areas of interest to ecotourism".

The Geography Department has been involved in a multidisciplinary research on the urban water village, Kampong Ayer, which has long been posing pollution and waste disposal problems. The Public Policy and Administration Department is active in environmental policy research.

Currently, UBD may be capable of contributing to a postgraduate (master's) program in CAM in the following specific aspects:

1. water quality management and pollution control;
2. sedimentation transport - fluvial and coastal marine;
3. human geography - housing and environmental aspects;
4. resource economics;
5. economic and environmental policy;
6. resource ecology;
7. resource conservation and management; and
8. ecology of coastal ecosystems - mangroves, peat swamps, mud-flats, sandy and rocky shores, coral reefs, seagrass beds, estuaries, freshwaters and secondary lowland rainforests.

Proposed Education and Training Programs on Coastal Area Management in Indonesia

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Abstract

Coastal areas in Indonesia are presently undergoing considerable exploitation leading to increasing pressure on the ecosystems. Courses relevant to coastal area management (CAM) were introduced in the country's educational institutions as a response to the demand for experts. At present, 11 public and 13 private universities offer undergraduate courses on fisheries and 1 has a postgraduate program related to CAM. However, there is no single integrated course on CAM. To meet this need, postgraduate and regular short-term training programs must be established.

Introduction

The Indonesian archipelago consists of some 13,500 islands with a total coastline of about 81,000 km. Since the early times, the coast, especially around estuaries, has been used for human settlement and many economic activities due to the availability of natural resources and transportation facilities. Of 27 capital cities of provinces, 21 are situated in the coast.

The increasing domestic and industrial wastes in coastal areas have significant ecological effects on the living natural resources. Knowledge of the various species and their population dynamics is essential in developing programs to preserve the biological diversity of coastal ecosystems.

Higher education to fill the need for experts in utilization and management of living coastal resources in Indonesia started in the early 1960s. Generally, higher education related to CAM is under the Faculty of Fisheries. The first such faculty was established in 1963 in Bogor Agricultural University (BAU). Since then, several other universities have established their own programs.

The Faculty of Fisheries consists of six study programs: Living Aquatic Resources Management, Aquaculture, Fishery Resources Utilization, Fishery Product Technology, Fishery Socioeconomics and Marine Science and Technology.

At present, 11 public and 13 private universities offer fisheries courses which are relevant to CAM. Some provide courses on coastal engineering. However, until now, no single integrated course on CAM is taught in the country's universities.

In the postgraduate level, BAU offers Aquatic Sciences, Natural Resources and Environmental Management, and Regional and Rural Development Plan as study programs related to CAM.

Proposed Education and Training Programs

Postgraduate Program

The main objectives of the postgraduate program on CAM are to increase the students' capability to understand coastal systems, undertake research and provide solutions to CAM problems by using an integrated approach. The course curriculum will be divided into core and elective subjects. The student has to take all core and three elective subjects.

Core subjects

Biology of Estuaries and Coastal Waters: physical and chemical features of, primary and secondary productivity of and water movements in estuaries and coastal waters; sources of sediments.

Coastal Fisheries and Management: aquaculture (including mariculture) practices and their management; fishing activities; impact of aquaculture development and fishing activities on coastal environment; management of coastal fisheries.

Planning and Development of Coastal Area: national economic growth and development; resources allocation; development valuation; regional

economic analysis; resources potential assessment; marine and coastal production analysis.

Coastal and Marine Pollution: wastewater biology and characteristics; collection, treatment and disposal of industrial waste; toxicity testing; bioassay; biological indicators and monitoring of pollution; eutrophication.

Coastal Environmental Impact Assessment: objectives and concepts; procedure and methodology; evaluation (physical, chemical, biological and socioeconomic impact); legal aspects and standard environmental quality.

Statistical Methods: sampling techniques; data collection and analysis; statistical analysis; software packages.

Conservation and Rehabilitation of Coastal Environment: basic concepts of conservation and management; legal aspects of conservation; zone determination.

Elective subjects

Law and Legal Aspects: role of legislation in CAM; Law of the Sea; problems of enforcement; international conventions on marine pollution; exclusive economic zones.

Environmental Remote Sensing: Landsat and Satellite Probatoire pour l'Observation de la Terre (SPOT) satellite imagery; uses and limitations of Landsat multispectral scanner and thematic mapper images in coastal habitat mapping; pollution monitoring and bathymetry; trends in sensor development.

Tourism and Marine Park: Tourism; marine parks conservation; conflict of interest, habitat evaluation and management policy.

Resource Economics: methods of economic analysis; socioeconomic ramifications of coastal zone management; theory of consumption, production, demand and market; characteristics of resource economy; social criteria for decisionmaking.

Fish Population Biology: population with and without age structure; multispecies predator-prey relationship; evolution and adaptation mechanism (natural selection, population parameters, age structure); variation of growth parameter based on age; growth dependent on population density; use of length frequency on fish population analysis; fish population genetics.

Simulation and Model of Coastal Ecosystem: role of simulation and model on coastal resources management; principles and procedures of modelling; multicomponent model systems; application of mathematical models for simulation of fisheries resources management using micro-computer.

Regional Information System: presentation and interpretation of maps, satellite imagery, aerial photographs, etc.; special topics on computer-based spatial interpretation for land use planning and other natural resources (e.g., geographic information system).

Planning of Space System: regional economic consideration with social activities in rural development; relationship between social center activities and center hierarchic structure; interdependency aspect; analysis of coastal geography.

Natural Resource Economics: problems of resources allocation at the national, regional or local level in relation to economic changes, population growth, technology, dynamics of social changes and availability of natural resources; application of socioeconomic sciences to natural resources allocation policy; analysis of natural resources allocation in space and time; property right issues.

Applied Operations Research: problem approach and construction of decision model; program formulation using nonlinear models such as probability dynamics, Program Evaluation and Review Technique-Critical Path Method (PERT-CPM) and others; application of each model in either macro- or micropolicy analysis for natural resources and environment.

Regional Economic Research Methodology: basic philosophy of research and the role of economic research in social system; problem of economic research in developing countries; specification and priority of research; structure of economic theory problem formulation; construction and evaluation of model; procedure and steps in research; data analysis and result interpretation; technical writing of research results.

Regional Physical Resources and Land Use: utilization technique of basic physical resources (soil/land and water) for rural planning; use of information on land and regional capability and techniques of land and water conservation and control.

Port Management: function and role of port on coastal development planning; analysis of interrelationship among interland, foreland and port; port environment; socioeconomic interdependence between worker and local society; impact of port on socioeconomics; demography of coastal society.

Applied Oceanography: role and process of oceanography on fish behavior such as migration and population density; application of remote sensing on the management and utilization of living aquatic resources; dynamics of water movements in coastal water.

Coral Reef Ecosystem: coral reef definition, distribution and structure; coral reef as an ecosystem, its biotic and abiotic components and ecological processes; critical environmental parameters for maintenance of ecological processes; coral reef resources utilization and impact on the ecosystem; major sources of stress to coral reef ecosystems and potential associated effects.

Mangrove Ecosystem: mangrove swamp forest definition, distribution and structure; mangrove swamp forest as an ecosystem, its biotic and abiotic components and ecological processes; critical environmental parameters for maintenance of ecological processes; ecological and economic importance of mangrove swamp forest; major sources of degradation of mangrove ecosystem.

Short-term Training Course

Aside from the same objectives as the postgraduate program, the short-term training course also aims to promote interdisciplinary collaboration and integration in CAM. Young scientists with a background in biology, fisheries or economics are eligible for a six-week training course which includes practical work and project assignment.

Course outline

Research Methodology: statistical and biological analysis and sampling techniques; economic research methodology; model and simulation; applied operations research.

Structure and Functions of Coastal Ecosystem: biological studies of estuaries and coastal waters; dynamics of coastal ecosystem; major biotic divisions in coastal zone (estuaries, mangroves, seagrass beds, coral reefs, coastal waters); marine pollution.

Coastal Resources Utilization: coastal aquaculture and fishing practices; impacts of aquaculture development and fishing practices on coastal environments.

Coastal Fisheries Resources Management: coastal fisheries economics and management; fish population dynamics and genetics.

Planning and Policies: regional and local planning; laws and regulations.

million km². Most of the 185 million inhabitants live in the coast. Proper exploitation of coastal resources is an important economic development objective of the government, but this is hampered by the lack of well-qualified professional manpower. In this regard, coastal area research and management capabilities in Indonesia require upgrading. This task is the responsibility of the Ministry of Education and Culture.

Study Program on Marine Science and Technology

In the country's current Five-year Development Plan (REPELITA IV -- 1984/85-1988/89)), UNDIP in Semarang, Central Java, has been assigned to study the coastal zone and its problems. It is UNDIP's responsibility to develop management skills needed by the government for its long-term plans to exploit coastal resources for sustainable development.

UNDIP is a state university established in 1960. Basic science courses are offered in its main campus in Semarang while applied science courses are taught in Jepara, 80 km northeast of Semarang. Facilities include the well-equipped Coastal Region Ecodevelopment Laboratory.

UNDIP's research institutes continue to collaborate with the Overseas Development Administration of the United Kingdom. Since the university's establishment in 1969, it has graduated 553 fisheries scholars.

The Study Program on Marine Science and Technology at UNDIP uses a semester credit system (Table 1). A credit of one semester hour represents the satisfactory completion of the work in one tutorial hour a week for a period of one semester (16 weeks). A course having three tutorial hours a week, therefore, will give three semester hours of credit. To finish the course, the students must earn a total of 152 credits, including practical work. Until the academic year 1990/91, the study program at UNDIP enrolls 230 students. In 1992, some graduate students will be accepted.

At present, the Fishery Department of the Faculty of Animal Sciences has enough academic staff consisting of 1 professor, and 8 Ph.D. and 13 M.S. degree holders. Aside from the laboratory, the other facilities are the research boat, model dike and hatchery in Jepara.

Coastal Management Study Program

The Coastal Management Study Program is conducted through the science division. It aims to produce scholars with the abilities to:

Table 1. Curricula content of the study program on Marine Science and Technology at UNDIP.

Course title	Credits	Course title	Credits
General subjects		General marine biology and ecology	
Religious Education	2	Marine Ecology	3
State Ideology	2	Marine Biology/Field Study	3
Village Sociology/Basic Sociological Science	2	Marine Zoology	3
Indonesian Language	2	Marine Botany	3
English Language	3	Planktonology	3
Military Education	2	Marine Invertebrates	3
Introduction to Economics	2	Marine Microbiology	2
Community Service	3	Nutrition of Marine Fauna	3
Basic Cultural Science	2	Special marine biology (species group)	
Research Methodology	2	Ichthyology	3
Design of Experiments	3	Malacology	3
		Corals	3
Basic mathematics and other natural sciences		Aquaculture, biotechnology	
Mathematics I	3	Mariculture	3
Mathematics II	3	Introduction to Biotechnology	3
Chemistry I	3	Fish Breeding	3
Chemistry II	3	Artificial Reef	3
Physics I	3	Genetic Engineering	3
Physics II	3	Diseases of Marine Fauna (Toxicology)	3
Introduction to Computer Science	3	Mariculture Engineering	3
Statistics	3	Cultivation Techniques for Seaweeds	3
Law of the Sea	2	Cultivation Techniques for Marine Fish	3
Geology	2	Cultivation Techniques for Crustaceans	3
Physical Chemistry	2	Cultivation Techniques for Bivalves	3
General marine science and technology		Cultivation Techniques for Echinoderms	3
Introduction to Marine Science and Technology	2	Biotechniques of Marine Fauna Cultivation	3
Introduction to Oceanography	3	Nutrition and Food Technology	3
Marine Meteorology	3		
Physical Oceanography/Field Study	4	Others	
Coastal Engineering	3	Fieldwork	2
Chemical Oceanography	3	Thesis	6
General biology, ecology and physiology		Seminar	2
Biology I	3		
General Ecology	2		
Biology II	3		
Genetics	3		
Microbiology	3		
Physiology of Aquatic Fauna	3		
Biochemistry	3		

Note: 2 credits Theory only
2,4,6 credits Theory and Practical Work

1. master coastal resources management principles;
2. formulate concepts systematically and analyze factors influencing each other in the coastal ecosystem;
3. solve problems in the coastal area as well as formulate development plans; and
4. work independently in one's department as well as in a group of multidisciplinary institutions handling CAM problems.

The Master of Science Degree Program in Coastal Management takes two years or four semesters. Students should earn at least 47 credits.

All requirements for an M.S. degree have to be completed within four years after the student is registered.

The requirements for acceptance as a full student are an undergraduate degree and an achievement index of 2.5-2.75 at the scoring scale of 0-4 or 6.0-6.25 at the scoring scale of 0-10. He/she must also submit his/her own scientific report and a recommendation from the head or senior academic staff of his/her original university. A full status will be given after the student has participated in a one-and-a-half month matriculation program consisting of English, Basic Statistics and Scientific Writing.

Subject syllabus in coastal management

First semester

Coastal Ecology (3 credits): mutual relations between living things and the coastal environment; relations as well as differences between seawater and brackishwater, and human activities which influence both.

Coastal Natural Resources (3 credits): terms for various resources; ecology; kinds and characteristics of coastal natural resources; kinds of used and unused resources.

Coastal Human Resources (3 credits): types, characteristics, distribution and organization of coastal communities; human ecology and potential and underdeveloped conditions in coastal areas.

Statistical Analysis (3 credits): basic statistics; testing hypothesis; linear and multiple regression; simple and multiple correlation; discrete data analysis; examples of application.

Second semester

Law and Environment (3 credits): conflicts of interest in the use of field/space and the need for organization; laws on living environment in Indonesia; problems in applying environmental laws; case study of coastal pollution; application of the government's environmental impact assessment (EIA) regulation.

Coastal Resource Economy (3 credits): problems in coastal resources allocation at the local, regional or national levels in relation to changes in

the economy, population, technology, community and resources; models of projection and simulation in coastal resources use in relation to decisionmaking scheme; analysis of coastal resources allocation in relation to season, kinds of commodities and the controlling rights which influence coastal resources reservation and efficiency.

Fisheries Network Planning (3 credits): fisheries planning at both regional and national levels; the relationship between departments/institutions and universities toward a useful fisheries development.

Coastal Area Planning (3 credits): management principles of natural and human resources based on the maintenance of the optimal quality of the coastal ecology and ecosystems; integrated and sustainable coastal area planning methods.

Research Methodology (3 credits): theory scheme and research problems; different purposes and research methods; role of statistics in research; methods of writing research proposal, research report, scientific article or manuscript and thesis.

Third semester

Research Planning Colloquium (1 credit): based on thesis research planning concept, oral reports given by the student in a forum, with explanation of study methods to be used in data collection, analysis and synthesis.

Four optional subjects of 3 credits each should also be taken.

Optional subjects

Coral Reef Ecosystem (3 credits): types, functions and existence (nutrition, physiology and reproduction) of corals along tropical coast; growing methods; methods of quantitative measurement.

Coastal Vegetation Ecosystem (3 credits): kinds and composition of coastal vegetation; biogeography, physiology, morphology, embryology and other discipline-oriented studies; role of vegetation in coastal areas; impact of human activities on coastal vegetation.

Estuary and Lagoon Ecosystem (3 credits): understanding lagoon/estuary and their characteristics, vegetation and organisms; dynamics of structural and functional interrelationships; physical, chemical and biological processes with regard to the producer-consumer-and-decomposer relationship and human exploitation in lagoon and estuary.

Coastal Environment Preservation (3 credits): ecology concept of the carrying capacity of the coastal environment; shoreland, estuary, nearshore, barrier and beach systems; management of different coastal environments.

Coastal EIA (3 credits): its function, usage, procedure/methodology and evaluation; physical, chemical, biological, socioeconomic and cultural impact; laws and regulations and quality standards in coastal area in Indonesia.

Coastal Area Resources Conservation (3 credits): objectives, basic concepts and kinds of conservation; biological/ecological diversity of vegetation and organisms; management of conservation areas.

Fisheries Resources Management (3 credits): kinds and characteristics of fisheries resources; history of fisheries development; under- and over-fishing; artistic and industrial fisheries; aims of fisheries management; national fisheries resources use; role of research in fisheries management; issues and factors in formulating fisheries management policies.

Brackishwater Management (3 credits): function and use of brackishwater as supporting area between sea- and freshwater; chemical, physical and biological factors which influence flora and fauna in brackishwater; principles and approach in brackishwater management.

Modelling (3 credits): concepts of system, classification and system analysis; model and simulation; objectives and principles of modelling; model classification; mathematical model; approach in model development; samples of models in coastal ecology.

Social Energy (3 credits): understanding social energy; functions of integration between social system and coastal ecosystem; coastal system; potentials of coastal social groups; social energy use in development; coastal village/community development; social crisis.

Coastal Village Sociology (3 credits): understanding coastal village/community structures and characteristics to accelerate development efforts; considering these characteristics in formulating development objectives and in understanding the social impact of the changes brought about by development.

Environmental Sanitation (3 credits): understanding environmental sanitation and its influencing and limiting factors; sanitation planning system for physical and biological environment; evaluation methods of coastal environmental sanitation programs.

Fourth semester

Seminar (1 credit).

Research and Thesis (6 credits).

Marine and Environmental Science Education Relevant to Coastal Area Management and Planning in Malaysia

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Abstract

The Malaysian government's initiative for a holistic coastal area management and planning (CAMP) saw the need for trained specialists in this field. This led to advances towards an integration of sciences for environmental and CAM education at the tertiary level. An evaluation of the curricula of four universities in the country singles out the courses relevant to marine and environmental studies, which are classified into eight subject areas. After weighing the strong and weak points of each subject area, a sufficient coverage of basic sciences was found and reinforcement of significant topics such as coastal engineering, marine and coastal processes, environmental impact assessment (EIA) and marine policy and affairs, was recommended.

Introduction

CAMP is a fairly new concept in Malaysia. There is no defined coastal zone in the country and its contribution as a productive resource system is poorly understood. Thus, many planners do not consider the special

management needs of the coastal zone and few are aware of CAMP concepts. The need for integrated management of the coastal resources and habitats has only been realized by the government after many of them have already been heavily depleted and degraded. National efforts have been initiated in the last few years, such as the establishment of some islands as marine parks for protection of fish spawning grounds or the delineation of a specific stretch of beach as a turtle breeding ground.

At the regional level, Malaysia and its Southeast Asian neighbors jointly undertake marine science research through the Association of Southeast Asian Nations (ASEAN) Working Group on Marine Science, established in 1978. The venture, with support from Australia, Canada and the United States (US), develops research, management and training programs in marine sciences with emphasis on resources assessment and coastal management. Multidisciplinary teams of scientists are involved in data gathering. Of particular interest to Malaysia is the ASEAN/US Coastal Resources Management Project which has selected Southern Johore as the pilot study site.

At present, there are no specific criteria or guidelines for marine environment conservation and strategies yet, but the Department of Environment has proposed that these two topics be studied under the Fifth Malaysian Development Plan. With the increasing awareness of coastal environment problems, a growing need for trained marine management personnel is expected.

Much of the training and education relevant to coastal zone management (CZM) have been derived from the various conventional disciplines such as zoology, botany, geography, engineering, chemistry and physics. The management strategy used was sectoral. The first steps towards an integrated approach to CZM at the tertiary level took place in the mid-1970s.

The first local degree course in Environmental Sciences was established in 1978 and the first Faculty of Fisheries and Marine Sciences, in 1979. Both were set up in the Universiti Pertanian Malaysia (UPM) with a tradition for integration of science education for field application and management. Although it appears that there is a concentration of expertise in environment, fisheries and marine sciences, other expertise relevant to CAM are found in various government agencies and faculties of universities. Of the six universities in Malaysia, five conduct courses which are relevant to CAMP (Table 1).

In general, UM follows the traditional divisions in university education. There are Faculties of Sciences, Engineering, Humanities, Economics, Law and Medical Sciences. The UKM has similar divisions, although it has additional faculties for applied and broad-based studies, such as Development Science and Islamic Studies. The USM provides a more liberal and broad-based education. The UPM and UTM, as their names imply, are primarily devoted to applied sciences for agriculture and technology.

Table 1. Educational institutions in Malaysia offering courses relevant to CAMP.

University/academy	Year established	Location	Branch
Universiti Malaya (UM)	1962	Kuala Lumpur	
Akademi Islam	1981	Kuala Lumpur	Nilam Puri, Kota Bharu and Kelantan
Universiti Kebangsaan Malaysia (UKM)	1970	Bangi, Selangor	Kota Kinabalu, Sabah
Universiti Pertanian Malaysia (UPM)	1971	Serdang, Selangor	Bintulu, Sarawak
Universiti Sains Malaysia (USM)	1969	Pulau Pinang	Kubang Kerian, Kelantan
Universiti Teknologi Malaysia (UTM)	1972	Skudai, Johore	Kuala Lumpur

Courses Relevant to Coastal Area Management and Planning

In four universities, the courses relevant to marine and environmental sciences are classified into eight subject areas (Table 2). Each subject area, weighed by the number of hours/year, is given in Table 3.

Basic sciences education (with a total of 3,256 hours/year) relevant to environmental and marine matters is adequate. Though engineering courses are sufficient, there is a need for increased emphasis on coastal engineering and the specific conditions of the coastal area.

Other topics which should be strengthened are Marine Pollution, EIA and Marine Affairs. The legal process of EIA is new in Malaysia and expertise is only starting. There are fewer opportunities for Marine Pollution studies which usually have a more expansive coverage than Land-based and Freshwater Pollution studies. Marine Affairs has traditionally been tackled in Legal or Shipping studies. It should be integrated into Environmental Policy or Coastal Management courses.

Planning Tools and Resources Management deals with general techniques, such as aerial photography interpretation, modelling, forestry or agricultural management. More case studies of coastal areas need to be incorporated.

Table 2. Courses relevant to marine and environmental sciences offered in universities in Malaysia.

Course title	No. of hours	Type ^a
<i>UKM</i>		
Faculty: Life Sciences		
Department: Zoology		
Aquatic Biology	28	1
Advanced Ecology	28	1

Continued

Table 2. (continued)

Course title	No. of hours	Type ^a
Department: Botany		
Natural Resource Management	28	5
Coastal Ecology	28	1
Forest Ecology and Management	28	1
Environmental Pollution and Conservation	28	6
Land and Water Ecology	28	1
Plant Ecology	28	1
Faculty: Engineering		
Department: Civil and Structural Engineering		
Practice of Geotechnical Engineering	28	2
Introduction to Port Engineering	28	2
Engineering Hydrology II	28	2
Hydraulics	28	2
Public Health Engineering	14	2
Geotechnical Principles	28	2
Engineering Hydrology I	28	2
Department: Chemical and Biochemical Engineering		
Pollution Control	28	6
Department: Mechanical and Material Engineering		
Environmental Pollution Control	28	6
Faculty: Social Sciences and Humanities		
Department: Geography		
Quantitative Techniques I	42	1
Physical Geography II	42	1
Biogeography	42	1
Urban Environmental Studies	42	4
Remote Sensing in Geography	42	4
Urban Geography	42	1
Industrial Geography	42	1
Quantitative Techniques II	42	4
Tourism Studies	42	5
Hydrology	42	1
Coastal Geomorphology	42	1
Applied Climatology	42	1
Transport Geography	42	1
Tropical Geomorphology	42	1
Population Geography and Human		
Resource Planning	56	5
Environmental Studies	56	1
Coastal Studies	56	1
Urban Planning	56	4
Regional Development	56	4
UM		
Faculty: Sciences		
Department: Biochemistry		
Soil Science	48	1
Forest Resource and Management	48	5

Continued

Table 2. (continued)

Course title	No. of hours	Type ^a
Department: Botany		
Forest Research and Management	48	I
Department: Zoology		
Ecology and Environmental Measurement	48	4
Tropical Ecosystem	48	1
Pollution Biology	48	6
Environmental Chemistry	96	1
Environmental Biology and Population	48	1
Aquatic Environment	48	1
Ocean System	48	1
Natural Resource Ecology	48	1
Fish Biology	48	1
Limnology	48	1
Oceanography	48	1
Fish Ecology and Aquaculture	48	5
Environmental Equilibrium	24	1
Department: Geography		
Town Planning Theory and Practice	96	4
Introduction to Meteorology	96	1
Biogeography and Soils	96	1
Geomorphology	96	1
Hydrology	96	1
Air Photography Interpretation	96	4
Urban Geography	96	1
Transport Geography	96	1
Agriculture Geography	96	1
Area Planning	96	5
Industrialization Process in Developing Nations	96	3
Water Resources Development	96	5
Climatology	96	1
Agriculture Ecology	96	1
Natural Resources and Land Use Planning	96	5
Department: Geology		
Photogeology and Geomorphology	56	4
Hydrogeology	56	1
Economic Geology	56	3
Environmental Chemistry	56	1
UPM		
Faculty: Science and Environmental Studies		
Department: Biology		
Aquatic Biology	42	1
Tropical Forest Ecology	42	1
Department: Chemistry		
Industrial Chemistry I	42	1
Industrial Chemistry II	42	1
Industrial Polymer Chemistry	42	1
Industrial Chemistry	42	1

Continued

Table 2. (continued)

Course title	No. of hours	Type ^a
Department: Forest Management		
Introduction to Natural Resources	28	5
Watershed Management	42	5
Land Use Planning	42	4
Forest Policy and Law	28	8
Recreational Land Management	42	5
Faculty: Fisheries		
Department: Fishery Biology and Aquaculture		
Marine Fish Culture I	28	5
Invertebrate Culture	42	5
Aquatic Botany	28	1
Marine Fish Culture II	28	5
Ornamental Fish Culture	28	5
Fish Clinical Microbiology	28	1
Fish Parasitology	28	1
Breeding and Genetics of Fish	42	1
Inland Fisheries Management	28	5
Recreational Fisheries	42	5
Biological Oceanography	28	1
Water and Soil Analysis	28	1
Aquaculture Design	28	4
Shipping Studies	42	2
Navigation	42	1
Fish Handling	28	5
Fishing Technology	28	2
Marine Technology	28	2
Navigation Instruments	28	2
Fishing Boat Technology	28	2
USM		
School: Biological Sciences		
Department: Biology		
Limnology and Physicochemical		
Oceanography	42	1
Plankton and Productivity	42	1
Aquaculture	42	5
Dynamics and Management of Mangrove	42	5
Fisheries Management	42	5
Aquatic Pollution	42	6
Tropical Ecosystems	42	1
Environmental Pollution	42	6
Ecology of Natural Resources	42	1
Conservation Ecology	30	5
Environmental Management	42	7
Freshwater and Marine Biology	42	1

^aSee Table 3 for subject area equivalents.

Table 3. Weightage (hr/yr) of subject areas relevant to CAMP.

Type	Subject area	UKM	UPM	UM	USM
1	Physical Sciences	700	1,576	770	210
2	Engineering	182	NA	448	NA
3	Socioeconomics	NA	152	98	NA
4	Planning Tools	238	296	364	NA
5	Resources Management	126	384	630	156
6	Marine Pollution	84	48	42	84
7	EIA	NA	NA	56	42
8	Marine Affairs/Policy	NA	NA	336	NA

NA - Not available.

A Proposed Curriculum for a Master's Degree Course in Coastal Area Management in the ASEAN Region

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Abstract

This proposed master's degree program in coastal area management (CAM) reflects the need for such a training in the Association of Southeast Asian Nations (ASEAN) region. The course aims to lay down the theoretical/factual foundation for a solid grasp of the complexity of CAM problems, furnish the techniques/methodology to solve them and provide practical experience to undertake projects. Graduates of the course are envisioned to be generalists who will plan and implement programs, and coordinate and integrate the efforts of a pool of specialists from diverse disciplines. Such a CAM curriculum is outlined in this paper.

Introduction

This proposal for a master's degree course in CAM is based on the assumption that there exists a need for such a training and that the course could be offered on a collaborative basis among various academic institutions in the ASEAN region. The recognition of such a need appears

Projects (6 units): a review-type or field-oriented project which would expose each student to independent work, supervised by an academic staff member/course instructor.

Course Implementation

The planning and organization of a master's degree course of this nature and the preparation of teaching materials take a lot of time and effort. While the course is of one-year duration, efforts must be made to offer it for a period of not less than three years. To achieve this, course organizers should have an estimate of the potential number of student admissions.

A small core of permanent instructors in the host institution is needed to maintain continuity and establish contacts between the teaching staff and the students. There is also a need for experts from other countries to teach certain courses. In designing and implementing such courses, sufficient flexibility should be allowed to fit the course schedule with the availability of instructors.

If the course is to be offered on a regional basis, English must be the medium of instruction. Thus, some students may have to take a short intensive course on English of one to two months' duration prior to the main course.

Students who would enrol in the program are expected to come from diverse disciplines, which may have significant differences in academic standards. Hence, a rigorous screening procedure would ensure reasonably comparable entry requirements. Cooperation and collaboration among the participating educational institutions are essential to facilitate program operation.

Marine Science Education in the Philippines: Prospects for a Program in Coastal Zone Management

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Abstract

An interplay of social, economic, biological and environmental factors has heightened awareness of the significant role marine science education plays in the overall development of coastal countries like the Philippines. Currently, the Biology and Fisheries Departments in universities across the country offer courses relating to the marine environment but lack a purely marine science program, with the exception of the University of the Philippines Marine Science Institute (UPMSI), which offers M.S. and Ph.D. degrees in Marine Science. This paper explores the prospects for development of marine science education which zeroes in on coastal zone management (CZM) through a consortium of universities, with the possibility of an Association of Southeast Asian Nations (ASEAN) regional collaboration.

Introduction

In an archipelagic state such as the Philippines, one would expect to see marine science or environmental science education at an advanced

stage with a long history behind it. Surprisingly, this is not the case in most developing coastal countries, and the Philippines is no exception.

However, with the recent increasing awareness of the significance of these disciplines, be it due to marine pollution, decline of marine biodiversity or the expected sea level rise related to increasing global temperatures, there have been some developments in these fields. It is the object of this paper to make a brief review and to indicate future areas for development in marine science education, especially in the area of CZM.

Existing Programs

There is a preponderance of biology and fisheries curricula that focus on the marine environment in contrast with marine science programs as such. Other traditional curricula, e.g., engineering and management, may include course offerings related to CZM.

Many biology programs that have a marine option exist, especially in the universities in the south. Typically, the Biology Department of a specific university offers a biology degree with a major or concentration in marine biology, either at the baccalaureate or postgraduate level or both. Silliman University (SU) in Dumaguete City has had a long tradition in doing this. It also has an administrative unit that addresses marine research, the Silliman University Marine Laboratory.

While there is much interest in further developing marine science programs in many universities, the major constraint is the lack of faculty trained in marine science (Table 1).

In terms of fisheries education, there is a large number of schools at the secondary and tertiary levels in the country. The general inadequacy of marine science education at the secondary level in these technical schools is generally acknowledged (see Feliciano, this vol.). At the tertiary level, the traditional focus has been on fish production techniques, whether by capture or by culture. While fisheries in the Philippines include both freshwater and marine areas, production from the sea far outstrips that of the lakes and rivers. Hence, there is a bias towards courses dealing with the sea.

Only in the present period has fisheries education begun to address resources management in a significant way, perhaps as a consequence of the depletion of many stocks and continuing pressures on the fisheries, in many cases, due to destructive and illegal fishing practices. The fisheries schools have not traditionally addressed the issues of habitat destruction, although some attention is now being given to these.

At present, curricular programs that are wholly marine in content are essentially limited to UP; although a few other institutions are moving in this direction. These programs are at the postgraduate level and currently focus on marine biology and physical oceanography.

Table 1. Degree programs related to marine science offered in various educational institutions in the Philippines.

Institution	Current	Proposed
Ateneo de Davao University	B.S. Biology	B.S. Marine Biology
De La Salle University	B.S. Biology M.S. Biology	
Mindanao State University (MSU)-Iligan	B.S. Biology B.S. Marine Biology	
MSU-Marawi	B.S. Biology B.S. Marine Biology	
MSU-Naawan	B.S. Fish Capture B.S. Fisheries B.S. Mariculture	B.S. Aquaculture B.S. Coastal Engineering B.S. Fish Processing Technology B.S. Oceanography
MSU-Tawi-Tawi	B.S. Marine Biology Fisheries Technology (two-year course) B.S. Fishery Technology B.S. Inland Fishery B.S. Marine Biology B.S. Marine Fishery B.S. Marine Products Technology B.S. Oceanography (Physical/Chemical)	
San Carlos University	B.S. Biology B.S. Marine Biology M.S. Biology M.S. Marine Biology	
SU	B.S. Biology M.S. Biology	
UPMSI	M.S. Marine Biology M.S. Oceanography (Physical) Ph.D. Marine Science	
UP in the Visayas, College of Fisheries	B.S. Fisheries B.S. Fisheries Business Management B.S. Fish Processing B.S. Inland Fisheries B.S. Marine Fisheries M.S. Aquaculture M.S. Fisheries M.S. Fisheries Biology	M.S. Fishery Science (Gear Technology) M.S. Limnology M.S. Microbiology Ph.D. Aquaculture
Visayas State College of Agriculture	B.S. Agriculture	B.S. Biology B.S. Marine Biology
Xavier University	B.S. Biology B.S. Marine Biology	

In the mid-1970s, three master's degrees were instituted at the former College of Arts and Sciences of UP in Diliman, Quezon City. The marine biology program was more successful in attracting students but the physical oceanography program also got off the ground. Only the marine geology program failed to materialize. With the reorganization of the university in 1985 and the segregation of the College of Science from the other disciplines, UPMSI was organized from the pre-existing research unit known as the Marine Sciences Center. The new institute has the mandate of integrating all the marine science programs in the college.

At present, UPMSI offers two postgraduate degrees, an M.S. in Marine Biology and a Ph.D. in Marine Science. The present programs focus on marine biological science while the marine physical sciences are being developed. It is the objective of the institute to eventually offer marine physical science options to its students at both the master's and doctoral levels.

Table 2 presents the curricula currently offered. New courses are also periodically instituted as the needs arise and as the faculty increases. At this writing, the following courses are being processed by the relevant university curricular committees: Marine Pollution Chemistry, Biochemistry of Marine Organisms I and II, Marine Natural Products Chemistry, Marine Toxicology, Coral Reef Ecosystems and Marine Ecosystem Dynamics.

Virtually all of the courses offered are in the natural sciences. Since this is the orientation of the institute, there is a reluctance on the part of the faculty to broaden into CZM education, except insofar as existing or future "hard science" courses can be inputted to a multidisciplinary program that will involve other academic units. This attitude arises more from the limited size (12 Ph.D.'s) and from the technical background of the faculty of the institute rather than from a perceived insignificance of the subject area.

Prospects

It may be worthwhile to speculate on the range of possibilities for CZM education in the Philippines.

Currently, no single department in any university has the faculty to offer a total program. However, if two or three departments were to pool their resources together, it might be possible to put up the program. This could be done by a consortium of universities or by interdepartmental linkages within a large institution such as UP. If within the UP system, a possible assignment of responsibilities is shown in Table 3.

The subject areas indicate the participation of half a dozen possible units on two campuses of UP. While it is possible to involve a third campus, it is probably better to consider reducing the number of units taking part to make the program more cohesive and more manageable administratively.

Table 2. Marine science curricula at UPMSI.

M.S. Marine Biology: completion of at least 24 units of formal graduate courses--9 units of core courses and 15 units of electives; also, completion of one seminar unit and submission of a master's thesis.

Ph.D. Marine Science: with M.S.--completion of 9 to 12 units of core courses and a minimum of 15 units of electives; with B.S.--completion of 9 to 12 units of core courses and a minimum of 36 units of electives.

<i>Core courses</i>	<i>Credit units</i>
Physical Oceanography	3
Chemical Oceanography	3
Biological Oceanography	3
Geological Oceanography	3
<i>Electives</i>	
Marine Algae	3
Physiology of Marine Algae	3
Marine Zoogeography	3
Marine Mycology	3
Marine Agronomy	3
Management of Marine Resources	3
Marine Ecology	3
Marine Phytoplankton	3
Marine Zooplankton	3
Marine Microbiology	3
Seagrasses and Mangroves	3
Marine Chemical Ecology	3
Marine Fishes	3
Phylogenetic Systematics of Marine Organisms	3
Physiology of Marine Organisms	3
Reproductive Biology of Marine Organisms	3
Benthic Ecology	3
Plankton Ecology	3
Population Genetics of Marine Organisms	3
Methods in Marine Science	3
Special Topics in Marine Science	2
Research	3-9
<i>Seminar series:</i> A seminar is required every year after 12 units have been credited to the student's program.	1+
<i>Dissertation</i>	12

Note: Electives may include graduate courses from other units of the College of Science and the university if these are relevant to the student's research interests and approved by his Program Committee.

Table 3. Possible course assignments by unit in the UP system.

Subject area	UP unit
Resource assessment and inventory	UPMSI; UP at Los Baños-Institute of Environmental Science and Management (UPLB-IESAM)
Environmental impact assessment	UPLB-IESAM
Marine pollution	UPMSI
Socioeconomics	UPLB-IESAM; School of Economics
Marine affairs/policies	College of Law
Resource management	UPLB-IESAM; UPMSI
Physical science and engineering	College of Engineering (UPCE)
Planning tools	UPCE; UPMSI; School of Urban and Regional Planning

In addition to a strictly Philippine effort in CZM, it is also possible to envision a program that will serve the ASEAN region or even a wider clientele. The broadening of the scope could encompass a regional consortium, if such is felt to be desirable. Whatever proposal is advanced, it will be necessary to involve the highest officials of the collaborating universities in order to get a firm commitment.

Marine and Environmental Science Education and Training Relevant to Coastal Area Management and Planning in the Philippines

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Abstract

This paper traces the pertinent Philippine legislation governing marine and environmental science education and planning. While the laws and regulations have somehow expedited some research, education, training and development programs in the field, problem areas still remain. Recommendations were given to address these problems effectively. As environmental science education is a relatively new discipline in the Philippine setting, attempts have been made to integrate basic environmental concepts in the school curriculum. The University of the Philippines Law Center (UPLC) has initiated efforts to enhance public awareness in environmental issues and laws by introducing "functional legal literacy" to teachers, students and out-of-school youth. Given this current scenario, this paper states the necessity of a multidisciplinary approach in drafting a graduate program in coastal area management and planning.

Introduction

Environmental education and training activities are directed at three major groups (UNEP 1988), namely:

1. the general public - at all levels of formal education, and in various nonformal education activities for adults and specially the youth, as custodians of tomorrow's world;
2. specific occupational or social groups whose activities and influence have an important bearing on the environment (e.g., decisionmakers in industry and government; women involved in agricultural work in developing countries) - through formal education or nonformal methods in their profession or occupation; and
3. scientists and technicians working directly on specific environmental problems - through basic training in relevant sciences or technologies such as forestry, chemistry, ecology, toxicology, management of hazardous industrial processes and wastes, and agricultural engineering; supplemented by interdisciplinary training to convey a broad appreciation of environmental management and the social, economic and environmental factors that it must reflect.

General Environmental Education

Environmental education in the Philippines was passed into law in 1977. Article 53 of the Philippine Environment Code [Presidential Decree (PD) No. 1152 (1977)] provides the following:

The Department of Education and Culture shall integrate subjects on environmental education in its curricula at all levels. It shall also endeavor to conduct special community education emphasizing the relationship of men and nature, as well as environmental sanitation and practices.

The guidelines implementing this code (issued by the Ministry of Human Settlements in 1979) specify that in determining the substance and content of such subjects, the department shall consult and coordinate with the pertinent government agency or agencies carrying out environmental laws.

So far, the Department of Education, Culture and Sports (DECS) has not issued any memorandum circular dealing specifically with environmental education.

However, interviews with Dr. Lydia N. Agno of the Social Studies Department, University of the Philippines Integrated School (UPIS), reveal that environmental education is integrated into the Social Science courses at the elementary and high school levels. The subject is concerned with how customs and institutions emerge; how human beings are influenced by and in turn use and alter their environment to satisfy individual and group needs; how they attempt to solve current problems

and draw from experience in planning for the future (Agno 1983). Aspects of environmental education included in the contents of this course have been approved by DECS.

The experiment of the University of the Philippines Law Center

UPLC, in collaboration with the Faculty of Law, College of Education and UPIS, has undertaken a novel project called Teaching Practical Law, one of the six components of the Popularizing the Law Program. The main idea of this project is to provide functional legal literacy to students in elementary and secondary schools as well as to out-of-school youth. This is achieved through special optional courses and by integrating materials into the regular curricular offerings, e.g., Civics, Government and Social Studies. A basic curriculum consisting of six modules, which includes Environment and the Law, has been formulated. Concepts such as the legal protection of natural resources and the environment, including the Law of the Sea, pollution and zoning laws, are described in the module on Environment and the Law.

Specific activities in the Practical Law component are:

1. training teachers (mostly those in Social Studies) to teach Practical Law in mini- or optional courses integrated into the existing curriculum;
2. designing and developing teaching manuals for teachers and learning kits for students, designed jointly by lawyers, teachers and students;
3. networking with institutions, agencies and individuals, i.e., courts, *barangay* (community) officials, law enforcement agencies, legal aid clinics and administrative bodies, which provide the experimental component; and
4. disseminating the idea of teaching Practical Law to other schools, out-of-school youth and nonformal educational institutions.

To date, the UP College of Education and the Faculty of Law, under the sponsorship of DECS, have trained 4 groups of social science teachers from the 12 regions of the Philippines. It is hoped that eventually, the manuals on Practical Law produced for the pilot project of UPIS will be used in all public and private schools.

Marine Science Legislation, Education and Training

The earliest law which has a bearing on marine science education established the Board of Marine Examiners under the Revised Administrative Code [Act No. 2711 (1916), as amended, Sec. 1184]. This has been revised by PD No. 97 (1973) which regulates the practice of the marine

profession and examines officers. From 1977, this decree also requires fourth marine engineers to be graduates of marine engineering schools or hold equivalent degrees.

Likewise, any person applying for admission to the naval architecture and marine engineering examination must be a holder of a B.S. degree in these courses [Republic Act (RA) No. 4565 (1965), Sec. 11(d)]. An applicant for the practice of geodetic engineering must be a B.S. degree holder in this course from any educational institution recognized by the government, provided that said standard course includes the requisite core subjects [RA No. 4374 (1965), Sec. 15(d)].

Another law relevant to marine science development [PD No. 1588 (1978), Sec. 3(d)] established the National Cartography, Photogrammetry and Remote Sensing Center to meet the need for a continuing program of aerial photography and base mapping. Now renamed the National Mapping and Resource Information Authority, it is responsible for conducting research on remote sensing technologies such as satellite imagery analysis and airborne multispectral scanning systems. It shall also establish a nationwide geodetic network that would serve as a common reference system for all surveys in the country and conduct hydrographic and coastal surveys vital to the exploitation of our marine resources; and formulate and implement a nationwide development program on aerial photography, cartography and remote sensing mapping activities. Such services would accelerate the development of a comprehensive databank and information systems on base maps and charts.

The Coastal and Marine Management Program responds to a growing need among agencies with concerns in the Philippine coastal and marine areas to pursue cooperative efforts in their respective development and management thrusts. In the preparation of a national framework plan for the coastal and marine areas, a series of multisectoral assessment and planning activities was undertaken from 1983 to 1984. A survey on marine science and training in the Philippines (MHS 1984) delineated the distinction between marine science and marine technology education. Marine sciences include marine biology, chemistry, geology, oceanography and meteorology. Marine technology, on the other hand, includes fisheries and fisheries technology, marine and nautical engineering, and naval architecture.

A 1983 survey revealed that fisheries education is offered in UP in the Visayas and 70 other Schools of Fisheries. According to the Bureau of Fisheries and Aquatic Resources (BFAR), there are 6 Regional Fishermen's Training Centers, namely, in Cagayan, Albay, Samar, Cebu, Davao del Norte and Palawan. Maritime schools and training centers are categorized into 48 schools offering traditional courses, 8 schools providing marine technical courses and 16 schools/training centers giving upgrading courses. There are 31 marine engineering schools and 4 naval architectural schools. A total of 213 schools across the country offer marine science and technology courses. The same survey also identified the need to improve the following:

1. substandard quality of training for technicians in marine-related fields, especially in seafaring and communications;
2. inadequate and outdated laboratory equipment and facilities;
3. lack of quality faculty members;
4. insufficient financial support for scientists to conduct research and acquire opportunities for professional growth;
5. undirected education and training in marine fisheries, making it difficult for graduates and specialists to respond to the basic requirements of the beneficiary sector; and
6. lack of public awareness of the importance of marine sciences resulting in poor support.

Several recommendations were made to upgrade marine education. One is to strengthen the capabilities of existing universities, colleges, and training centers, instead of creating new ones, to bring about improvements on the above. These could be done through close collaboration among national and international institutions, such as UP in the Visayas, BFAR and Southeast Asian Fisheries Development Center. Two, the marine education curriculum should be made more responsive to the development needs of coastal and marine areas, and effective to generate more employment for graduates and specialists. Three, there is a need to reassess priorities and consider the linkages of marine sciences with social and environmental sciences. Basic marine and fisheries subjects should be included in secondary school curricula so that even noncollege graduates can acquire knowledge and basic skills in the field. Four, incentives should be given to scientists and professionals to encourage them to apply their education and expertise in the Philippines.

Environmental Legislation and Science Education

Philippine environmental policies are found in PD No. 1121 (1977) which created the National Environmental Protection Council; PD No. 1151 (1977) which spelled out the Philippine Environmental Policy; PD No. 1152 (1977) which is the Philippine Environmental Code; PD No. 1586 (1978) which established an Environmental Impact Statement System (EISS) and other environmental management related measures; and Proclamation No. 2146 (1981) which designated certain areas and types of projects as environmentally critical and within the scope of EISS under PD No. 1586.

Although there are 114 environmental statutes enacted from 1900 to the present, the basic laws dealing with the marine environment are: PD No. 43 (1972), which provided for the accelerated development of the fishery industry of the Philippines; PD No. 600 (1974), as revised by PD No. 979 (1976), which was on marine pollution; PD No. 704 (1975) which revised and consolidated all laws affecting fishing and fisheries; PD No.

1067 (1976), known as the Water Code; and PD No. 1219 (1978), the Coral Resources Development and Conservation Decree.

Under PD No. 1308 (1978), the practice of environmental planning shall embrace, *inter alia*, professional services in the form of technical consultation, plan preparation and/or implementation involving the:

1. development of a community, town, city or region;
2. development of a site for a particular need, such as housing, research center, education, culture, recreation, government industrial estate, agriculture and water resource; and creation of a spatial arrangement of buildings, utilities and communication routes;
3. land use and zoning for the management, development, preservation, conservation, rehabilitation and control of the environment; and
4. pre-investment, prefeasibility and feasibility studies [PD No. 1308 (1978), Sec. 3].

To qualify for examination, an applicant in the practice of environmental planning must be a holder of any of the following:

1. master's or bachelor's degree in environmental planning, city and regional planning or town and country planning, or its equivalent acceptable to the Board; the bachelor's degree holder must have two years of environmental planning experience certified by a registered environmental planner; or
2. master's or bachelor's degree in architecture, civil engineering, economics, public administration or sociology; a year of experience in environmental planning certified by a registered environmental planner, is needed for a master's degree and two years for a bachelor's degree [PD No. 1308 (1978), Sec. 16].

Applicants shall be examined on comprehensive plan preparation, which includes the following subjects: Physical, Social and Economic Planning; Planning Law and Administration; and Special Planning Studies.

Environmental science courses in UP

Two graduate programs in environmental studies exist in UP.

A. The Master's degree in Environmental Studies offered by the Institute of Environmental Science and Management in UP at Los Baños (UPLB-IESAM) includes the following courses:

Ecosystem Structure and Dynamics (3 units): ecosystem structure, function and models, energetics, nutrient cycles, population dynamics.

Issues in Aquatic Resources Management (3 units): problems and issues in the use of aquatic resources with emphasis on the Philippine situation.

Systems Analysis and Quantitative Methods in Natural Resources Management (3 units): statistical concepts and data analysis; optimization

techniques; stochastic modelling; application of the systems approach to resource-based problems.

Institutions and the Environment (3 units): social science approaches to the study of man-environment interactions; analysis of the interrelationships among culture, population and the natural environment; human response to changing habitats.

Environmental Impact Assessment (EIA): Perspectives from the Natural Sciences (3 units): framework and methodology for EIA; prediction and assessment of impacts on the physical and biological environment.

EIA: Perspectives from the Social Sciences (3 units): social evaluation and methodology for analysis of human-social impacts of development projects; community appraisal methods in ecological impact studies.

Special Topics (2 units).

Graduate Seminar (1 unit).

Master's Thesis (6 units).

B. In the College of Engineering, the Master's degree in Environmental Engineering offers the following subjects:

Introduction to Environmental Engineering (3 units): pollution control laws, regulations and standards; types, sources and harmful effects of pollutants; measurement of pollution parameters.

Environmental Engineering Laboratory I (3 units): examination and analysis of water and sewage as related to their treatment.

Special Problems (3 units).

Water Quality Control and Management (3 units): methods and economics of water quality control; river and estuary models for water quality parameters; water quality management.

Environmental Engineering Biology (3 units): freshwater biology; self-purification of streams; effects of thermal pollution; roles of organisms in trickling filtration and activated sludge; enzyme stabilization of organic matter.

Wastewater Disposal and Treatment (3 units): wastewater characteristics; stream pollution load; sewerage systems; physical and other wastewater treatment methods.

Biological Treatment Plant Design (3 units): theory of biological treatment processes and design of treatment plants.

Chemical Treatment Plant Design (3 units): theory of chemical treatment processes and design of treatment plants.

Tertiary Treatment Processes of Water (3 units): carbon absorption, reverse osmosis, dialysis and electrodialysis, ion exchange, equipment design.

Environmental Engineering Laboratory II (3 units): experimental study and equipment design of certain pollution control operations and processes.

Air Pollution (3 units): nature, sources, effects and control of air pollutants; sampling and analysis; monitoring and meteorological factors.

Particulate Systems (3 units): dynamic properties of particulate systems; diffusion and coagulation of aerosol particles; electrical properties of particles; electrostatic precipitation.

Solid Waste Disposal and Management (3 units): composition and quantity of solid wastes generated by residential, commercial and industrial establishments; disposal methods and management.

Radioactive Wastes (3 units): nature of radioactive wastes; processing and pretreatment of solid radioactive wastes; disposal methods.

Seminar (1 unit).

Thesis (6 units).

The School of Urban and Regional Planning (UPSURP) offers instruction leading to a Master of Arts degree in Urban and Regional Planning with the following specializations: Urban Planning, Regional Planning, Estate Planning and Development and Public Works Planning and Development. Among the core courses are:

Fundamentals and Practices of Planning (3 units): theories and concepts in urban and regional planning.

Land Use Planning (3 units): policies, land use planning and control measures for land development.

Regional Planning (3 units): nature and principles of regional planning and related operations.

Resource Use and Development (3 units): effects of resources use and development on social, technical and economic problems.

Regional Plan Implementation (3 units): administrative, fiscal, legal and other tools for regional plan implementation.

Conclusion

Most of the courses related to coastal area management and planning are offered in the Colleges of Science, Engineering and Fisheries, UPLB-IESAM and UPSURP. Definitely, a multidisciplinary approach to drafting such a graduate program is necessary.

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Marine Environment Education with Special Reference to Coastal Area Management: National University of Singapore

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Abstract

Currently, no separate marine science course is offered in the National University of Singapore (NUS). However, various courses covering a broad range of marine environment-related topics are taught in its different faculties which may be incorporated into the proposed coastal area management (CAM) curriculum. Aside from conventional areas of research, university staff have ventured into new technology in foreshore reclamation and creation of artificial islands. These breakthroughs have assumed greater significance in a country experiencing an infrastructure boom and consequently, a constantly changing shoreline. Sharing technological know-how could also benefit other countries in similar circumstances.

Introduction

The entire island republic of Singapore can be considered belonging to the coastal zone by virtue of its size. Due to a high population density

(currently over 4,000/km²) and lack of both physical space and natural resources, infrastructure development was accorded top priority. Accelerated since the 1960s, development has completely altered a significant proportion of the country's coastline.

However, marine science education with particular reference to coastal zone management (CZM) has not been given any special prominence. Basic principles of ecology and environmental science are introduced at the primary school level and developed through the secondary and college levels. At NUS, while marine science, particularly with reference to CZM, is not taught as a complete subject on its own, various related topics are offered as separate courses by the different faculties.

Marine Environment-Related Curricula

Faculty of Arts and Social Sciences

Few courses in the Faculty of Arts and Social Sciences cater directly to marine and coastal studies. Several courses in the Department of Geography cover some aspects of the marine and coastal environment and maritime-related topics. Perhaps the most directly related is Maritime Geography, a new course to be introduced in academic year 1991-1992. This course provides some background to oceanography and marine meteorology. Its main focus is on marine resources, international law governing seaspace, navigation, maritime trade and shipping, and maritime traditions. Some considerations will also be given to coastal and island resources and their management. Special reference is made to the seas in Southeast Asia.

The third-year level course on Political Geography deals with ocean boundary and disputes and the impact of the 1982 Convention of the Law of the Sea on the geography of Southeast Asia.

On the natural science side, aspects of coastal geomorphology which include coastal processes are found in the second-year course Geomorphology. The subject may be taught at a more advanced honors year level in the course Selected Topics in Geomorphological Processes. Aspects of hydrology affecting the coast is dealt with in the third-year course Hydrology while the second-year course Climatology deals with land and sea breezes, and air-sea interaction. The third-year course on Natural Hazards covers such topics as tsunamis and the impact of and human responses to typhoons and earthquakes along the coast and islands. The management of marine and coastal environments may in some years be included in an honors year course on Environmental Management.

The third-year course on Geography of Tourism includes discussion on coastal resources for tourism and the development of coastal and island resorts. Aspects of marine transportation and seaports form a small part

of the honors year course on Transportation Geography which discusses the operation of marine transport and ports with special reference to Southeast Asia.

Several courses on techniques in the Department of Geography are useful and can be incorporated in the CAM curriculum. There is a newly introduced third-year course on Remote Sensing and Geographic Information System (GIS). Maps on Singapore's coastal resources and activities are being digitized for use as case study for students. The course on Environmental Management deals with the use of environmental impact assessment (EIA) procedures.

In the area of survey techniques, the Methods of Social Research offered by the Department of Sociology, and Survey Methods, by the Department of Economics and Statistics, among other useful, fairly standard courses, can also be integrated into CZM education programs. There are also more advanced, rigorous courses offered to the "direct honors" students, i.e., exceptionally bright students who are given a three-year rather than a four-year program leading to an honors degree.

At present, no courses about resource and environmental economics within the Department of Economics and Statistics could be related to CAM. However, there are plans to introduce Environmental Economics which is described thus: "Economic theory is applied to environmental questions associated with resource exploitation; the problem of spillovers to economic processes; externalities and their management through economic institutions; and environmental impact analyses of proposed large-scale projects. Other topics include economic aspects of man's use and conservation of the environment; problems of sustainable production; various models on the interaction between economic and environmental processes; valuation of nonmarket environmental goods; macroeconomics of pollution; possible limits to economic growth arising from scarcity of environmental resources; and 'world models' of environmental catastrophe."

Faculty of Architecture and Building

The faculty consists of the School of Architecture and the School of Building and Estate Management (SBEM). The former does not offer courses specific to the coastal environment but provides general ones on environmental control which are concerned with the man-made environment. The Theory of Landscape Architecture (taught in the second year) and the Theory of Urban Design (third year) may have some relevance to the coastal area, with particular reference to tropical conditions.

The SBEM offers general courses which may have some applications to the coastal area: first-year courses, such as Surveying, Land Use and Development; second-year courses, such as Construction Economics I and Real Estate Economics I; third-year courses, such as Construction Technology II (Services), Real Estate Economics II and Town Planning I; and fourth-year courses which expand on these.

Construction Economics I covers the effects of governmental, social and economic policies on the level of construction; factors contributing to land use and value; and the role of developers in the private and public sectors. The economics of land use and the urbanization process are included in Real Estate Economics I, while urban renewal, economics of town planning and evaluation techniques on private and social costs and benefits including cost-benefit analysis of alternative land uses, are taken up in Real Estate Economics II. Drainage and sewage treatment and disposal are taught in Construction Technology II. Legal Studies I tackles land law (tenures and estates, leases and licenses, etc).

Faculty of Engineering

The Department of Civil Engineering provides a compulsory course in the fourth year, Hydraulic Engineering, that deals with theories on wave classifications and characteristics, energy and groundwater flow.

Optional courses in the fourth year are: Coastal Engineering which deals with tides and currents, waves, wave prediction models, coastal structures and wave forces on small bodies--aspects directly relevant to understanding the coastal physical processes; and Computational Hydraulics which tackles the application of computational methods to coastal engineering.

The Master of Science program of the department offers other CAM-related courses. Advanced Foundation Engineering contains a section on waterfront structures dealing with design loads, quays, jetties, docks, dolphins, breakwaters and special design considerations as well as a section on reclamation which covers methods and materials, dredging and geotechnical problems. Advanced Hydraulics tackles pollution problems in estuaries (with case studies), groundwater hydraulics relevant to coastal processes and the mechanics of sediment transport in streams (siltation and sedimentation processes in estuaries and along the coast). Offshore Structures is a more advanced version of the fourth-year Coastal Engineering course. The fourth-year Hydraulic Engineering course is expanded further in the M.S. course on Coastal Engineering. Finally, Water Quality Management considers physical and chemical parameters, biological aspects, sources and characteristics of wastewaters, streams and estuaries, eutrophication, outfall design, thermal pollution and urban stormwater management.

Faculty of Law

Two optional courses offered in the third and fourth years of direct relevance to the marine environment are Law of the Sea and Shipping Law. The former deals with territorial sea and international straits, exclusive economic zone, archipelagic concept, continental shelf concept, deep

seabed exploitation, unilateral legislation on deep seabed mining, settlement of disputes, delimitation questions on islands, and rights of other states in the economic zone (landlocked and geographically disadvantaged states). It also examines the trends at the Third United Nations Conference on the Law of the Sea especially as indicated by the latest conference tests. These trends are compared with the norms in the 1958 Geneva Convention as well as the customary law.

The Shipping Law course examines the law relating to the carriage of goods by sea and certain aspects of maritime law. The former covers the following topics: charter parties, bills of lading, loading, discharge and delivery, demurrage, general average, freight and the Carriage of Goods by Sea Act, Cap. 33 (1985 ed.) which incorporates the Hague-Visby Rules. Maritime law includes maritime liens, salvage, general average and Admiralty jurisdiction.

Faculty of Science

Marine science is not offered as a discrete course but topics are treated separately in the various courses of different departments.

A third-year course on Environmental, Energy and Economic Aspects of Industrial Chemistry is concerned with environmental pollution and its control. Remote Sensing is one of the optional courses at the honors level of the Department of Physics. The Department of Microbiology from the Faculty of Medicine has a second-year course, Morphology and Growth of Microorganisms, Microbiological Ecology and Genetics which discusses the microbiology of water and sewage, biodegradation and biodeterioration.

The study of marine communities and environment is included within the Department of Zoology's contribution to a final-year course, Ecology and Aquatic Biology. This course introduces the ecological principles concerning the marine environment and the use of equipment for physicochemical parameters measurement, survey techniques and ecological indices. The department also provides an optional topic on aquaculture and fisheries management in the third-year course, Vertebrates and Invertebrates. In the honors program, two optional courses are offered, Aquaculture and Fisheries Management, and Marine Ecology and Marine Fouling. The latter includes marine ecosystems such as coral reefs. Biometrics is taught at the final and honors years. There is a one-week marine field course in the honors program.

Marine Environment-Related Research

The details of several research undertakings together with some of the publications given below are indicative of the range of investigations on the coastal and marine environment conducted in the university.

Coastal environment and processes

The Departments of Geography, Botany and Zoology have a long standing interest in basic research on coastal and marine environments and processes. In the Department of Geography, much research on coastal geomorphology had been conducted (Wong 1973, 1985; Swan 1971). A survey of Singapore's marine environment made by Chou and Chia is included in the forthcoming book, *The biophysical environment of Singapore* (Chia et al., in press). Chou (1988) did some work on the sedimentation effects on coral reefs in Singapore. A study on the effect of reclamation on selected reefs in the country was carried out by the Department of Zoology. An ongoing project in the Department of Geography on sediment plumes from Johore River uses remote sensing techniques.

Resource assessment, inventory and management

There had been no proper assessment and inventory of marine and coastal resources prior to the mid-1980s. The survey provided by *The coastal environmental profile of Singapore* (Chia et al. 1988) was a product of the Association of Southeast Asian Nations/United States Coastal Resources Management Project (ASEAN/US CRMP). A series of maps on various aspects of Singapore's coastal zone will be included in the CZM plan for the country, also under the auspices of ASEAN/US CRMP. Efforts are now being made to digitize the information using the GIS program, ARC/INFO. A substantial amount of data on mangroves, coral reefs and soft-bottom benthic communities had been generated from a systematic program of baseline surveys conducted between 1986 and 1990 under the ASEAN-Australia Coastal Living Resources Project coordinated by the Department of Zoology (Chou, in press). Remote sensing (Barrier Reef Image Analysis or MICROBRIAN) is being used to assess the condition of coastal ecosystems in the country.

Environmental impact assessment

With the exception of unpublished studies on the impact of the petrochemical plant on Pulau Ayer Merbau and the environmental impact of Changi Airport, a comprehensive EIA on major development projects and activities in the coastal zone is yet to be made. The country does not require EIAs to be undertaken for major projects. Concern is basically focused on human health rather than on the environment per se.

Marine pollution

Studies on marine pollution caused by oil and heavy metals were undertaken by the Department of Geography (Rahman and Chia 1977;

Rahman et al. 1980). A survey on marine pollution was done by Goh in 1990. Continuing interest in this area of research is shown by a recent paper on ship-source marine pollution in Southeast Asia by Chia and McDorman (1990). The Department of Zoology conducted a study to assess the ecological impact of the relocation of the sewage effluent out-fall at Bedok. It has a few projects on heavy metal levels in rivers and coastal waters and is currently monitoring the return of marine life to rehabilitated rivers.

Marine affairs and policies

This is a broad category of research which covers such aspects as maritime traditions; the Law of the Sea; maritime boundary delimitation and conflicts; marine resources, management and policies; and strategic studies related to the sea. The Department of Geography staff produced two books on this, namely, *Southeast Asian seas: frontiers for development* (Chia and MacAndrews 1981) and *Southeast Asia and the Law of the Sea: some preliminary observations on the political geography of Southeast Asian seas* (Lee 1980).

The Department of History staff did research related to maritime traditions like Ng Chin Keong's which has special reference to southeastern China in the 18th and 19th centuries. From the Department of Sociology, Mariam (1985) researched on coastal communities and Wee (1986), on the ethnology of island communities in Riau Archipelago.

Marine recreation and tourism

This is an increasingly important area of research because of the flourishing tourism in the region as well as the rising demand for recreation by a growing affluent population. Research on this is being made by ASEAN/US CRMP. Wong (1990 a/b) undertook work both on the east coast of Peninsular Malaysia and in Singapore. Interest in marine tourism was also taken up by economists (e.g., Khan 1988).

Socioeconomic aspects

Chia et al. (1988) includes a survey of socioeconomic conditions and changes in the coast and islands affecting the population, and a preliminary valuation of the major economic coastal activities. However, much remains to be done in examining such aspects as the economic viability of island communities, value of coastal recreation and tourism, and cost-benefit of major development projects like industrial and power generation plants, oil storage facilities and marine aquaculture.

An innovative project on the design of a guide plan of a coastal town at Simpang, on the northeast coast of Singapore, was commissioned by the government.

Engineering procedures and responses

This topic may be regarded as man's adaptation and responses to the coastal environment as a result of the need for development. Research interest in this area is strong in Singapore. The Department of Civil Engineering staff have considerable expertise and research experience from projects undertaken in foreshore reclamation, including methods of shore protection, stabilizing beaches and coastlines, creation of stable soils and hydraulic engineering (Chua et al. 1989). They have, in particular, developed a cheaper technique for stabilizing reclaimed soils, i.e., by utilizing alternate layers of clay and sand. A research team from this department acted as consultant on land reclamation to the Port of Singapore Authority. The team has also explored the possibility of creating artificial islands as learned from the Japanese experience. They have tried making hydraulic models to simulate changes in flow patterns arising from changes in shorelines, and adding marine structures in the coast. With the large-scale development taking place along the shorelines and around the islands in Singapore, such expertise has assumed considerable importance. Technology transfer to similar situations elsewhere is also being tapped.

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Environmental Education Curricula at the Tertiary Level in Thailand: Case Study of Marine Science and Marine Affairs Programs

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Abstract

The alarming environmental deterioration in Thailand has been a major concern of successive national economic and social development plans. The ensuing development policies resulted in a review of environmental education and an ongoing revision of university curricula as an essential step towards developing national environmental management capability. The curricula have two approaches: the "generalist" or multidisciplinary approach, which gives an overview on environmental issues, and the "specialist" or in-depth approach, which aims to produce environmental scientists, engineers and community developers with their respective areas of concentration. The overall strategy is to produce graduates with the capability to cope with the complex issues of environmental management and sustainable development of coastal resources. This paper highlights the marine science and marine affairs programs at Chulalongkorn University as its case study.

Introduction

The natural resources and ecosystems in Thailand are in a critical state of depletion and degradation. Among the major global issues which cause this situation are rapid technology development and climatic changes. The key national issues relate to increasing coastal land uses for industry, aquaculture and tourism, overexploitation of natural resources and rapid population growth.

Environmental Education Curricula

The educational system in Thailand consists of formal and nonformal types. Formal education is divided into primary, secondary and tertiary levels. In the primary and secondary schools, the required age range is from 7 to 15. The law enforces that students must finish at least grade 6 or reach the age of 15 before they are allowed to get out of the formal educational system. In the tertiary level, most universities offer a four-year bachelor's degree, a two-year master's degree and a three-year doctoral degree.

Nonformal education is of two types: one is taught in school to reinforce formal learning and the other is a systematic program for adults and those formally out of the compulsory educational system.

The formal introduction of the environmental education curricula at the tertiary level began in the early 1970s. Mahidol University in Bangkok is the first institute to develop a program at the master's level in 1973. Several other universities in the country are now offering both undergraduate and postgraduate degree programs in Environmental Science and Engineering.

Thammasart University, Silpakorn University and Khonkhian University offer a B.S. in Environmental Science. Silpakorn University and King Mongkut Institute of Technology, among others, offer an M.S. in Environmental Science and related subjects.

The urgent need to cope with increasing environmental deterioration led to the upgrading of the environmental education curricula. This is reflected in the development policy presented in the Fifth-Sixth National Economic and Social Development Plans (1981-1990). The policy statement in the Fifth Plan aimed at building up public awareness on environmental conservation. In the Sixth Plan, the national policy targetted the improvement of infrastructure for environmental management directed at both organizational and personnel development. Pollution control and prevention issues neglected in the Fifth Plan are adequately provided for in the Sixth Plan. Thus, the curricula developed during the period 1981-1990 addressed the points raised in both plans, respectively.

These curricula can be categorized into two groups. The first, the "generalist", gives a general background on environmental issues using a multidisciplinary approach. Examples are the M.S. in Technology for Environmental Management (Table 1) and the M.A. in Social Science (Environmental Division) at Mahidol University; the M.S. in Environmental Science at Kasetsart University and Prince of Songkla University and the M.A. in Social Sciences, major in Environmental Studies, at Kasetsart University.

A postgraduate program in Coastal Resources Management (CRM) is being proposed at Prince of Songkla University and an M.S. in Marine Affairs at Chulalongkorn University in 1992.

The second group, the "specialist", provides in-depth education in environmental issues and protection. Examples are the B.S. in Environmental Engineering at three universities (Table 2), M.S. in Environmental Science at Chulalongkorn University (Table 3), M.S. in Public Health, major in Environmental Health, at Mahidol University (Table 4), and M.S. in City Planning and Environment at two institutions (Table 5). Other "specialist" programs are: Environmental Science Program and Architectural Program, Department of City and Town Planning, Chulalongkorn University; Environmental Health Program, Mahidol University; and Regional and Town Planning Program, King Mongkut Institute of Technology, Lardkrabang Campus.

Table 1. Master's degree program in Technology for Environmental Management, Mahidol University.

Compulsory courses	Units
Mathematics (Systematic and Cybernetics)	2
Environmental Economics	
Introduction to Economics and Management	2
Analysis of Environmental Economics	3
Population Studies	
Population Dynamics	3
Human Ecology	2
Environmental Pollution and Environmental Protection	
Environmental Pollution and Protection	6
Research Methods in Environmental Studies	3
Environmental Management	
Natural Resources Management	3
Environmental Management and Planning	2
Seminar	2
Case study	3

Note: An elective course of 2 units and a thesis equivalent to 12 units complete the course requirements.

Table 2. Bachelor's degree program in Environmental Engineering.

Structure of curriculum	Chulalongkorn University (1989) ^a	Khonkhian University (1983) ^a	Chiangmai University (1985) ^a
General basic subjects	68	67	60
Sociology	6	6	6
Humanities	6	6	6
English	6	8	9
Mathematics and Science	24	26	17
Engineering	26	21	22
General subjects on Engineering	8	-	6
Civil Engineering	-	5	5
Electrical Engineering	-	5	-
Mechanical Engineering	10	5	8
Industrial Engineering	8	6	-
Higher Mathematics and Statistics	-	-	-
Chemistry for Engineering	-	-	-
Biology for Engineering	-	-	3
Compulsory subjects	55	68	63
Higher Mathematics	3	-	-
Civil Engineering	6	-	-
Hydrology	4	-	-
Hydrography	2	-	-
Electrical Engineering	3	-	-
Mechanical Engineering	3	-	-
Engineering Survey	4	-	-
Sanitary Engineering	4	-	-
Environmental Engineering	26	38	27
Chemistry for Environmental Engineering	4	3	-
Biology for Environmental Engineering	3	3	-
Environmental Engineering	6	6	-
Engineering Design	8	9	15
Wastewater Treatment	-	9	6
Environmental Management	-	3	3
Economics of Environmental Engineering	-	2	-
Environmental Engineering Project	3	2	3
Field Study	1	Training (but noncredit)	-
Seminar	1	1 (Two subjects)	-
Elective subjects			
Compulsory subjects	18	3	6
From environment-related departments	9	3	-
Free elective subject	3	3	6
Total credit hours	153	144	135

^aYear of establishment.

Table 3. Master's degree program in Environmental Science, Chulalongkorn University.

Compulsory courses for all majors (13 units)	Compulsory courses for each option (12 units)	Elective courses (6 units)
Human Ecology (3)	Research Methods in Environmental Science (3)	Courses listed in the program or other departments in the Faculty of Science, or with the permission of the Program Committee
Environmental Economics (3)	Water Pollution (2)	
Environmental Impact Study (2)	Air Pollution (2)	
Environmental Management (3)	Soil Pollution (2)	
Seminar (2)	Noise Pollution (3)	

Note: A thesis (equivalent to 18 units) is a requirement.

Table 4. Master's degree program in Public Health, major in Environmental Health, Mahidol University.

Compulsory courses for all majors (not less than 9 units)

Principles in Communal Diseases (3)
 Biostatistics (3)
 Public Health Administration (3)
 Environmental Health (3)
 Behavior and Public Health (3)

Note: Compulsory courses for the program - 16 units.
 Elective courses - not less than 6 units.

Table 5. Master's degree program in City Planning and Environment.

Courses	Chulalongkorn University	King Mongkut Institute of Technology
Compulsory subjects	28	18
Division of Community Planning and Environment	18	15
Division of Policy and Administration in Urban and Regional Administration	2	3
Division of Economy, Urban and Regional Society	4	-
Division of Political Process and Social Changes	2	-
Division of Urban Transportation Planning Practice	2	-
	Noncredit	

Continued

Table 5 (continued)

Courses		Chulalongkorn University	King Mongkut Institute of Technology
Elective subjects			
Compulsory subjects	Division of City and Town Planning		9
Policy and Administrative Planning	2		-
Urban Development Processes	2		-
	Division of Regional Planning		
Local Administration	2		-
Rural Development	2		-
Basic Knowledge in Mathematics and Environmental Planning	-		3
Research Methodology	-		3
Systemic Education	-		3
Free elective subjects	4		9
	At least two courses in the Division of City and Environmental Planning or other courses with the approval of the department		Any course in city and environmental planning
Thesis		12	9

Strategies on the Development of Environmental Education Curricula

Although environmental education is now accepted as one of the more important fields in Thailand, the number of students is not yet sufficient to meet the demand of the government and the private sector. At the master's level in the Area Concentration Program (specialist), the estimated graduates per year are 65-70 while the Multidisciplinary Environmental Study Program (generalist) is expected to produce only 55 graduates per year. These figures are less than the needs for both fields in the job market which have an equal ratio of 160 persons per year.

Thailand aspires to be one of the heavy-industry countries, according to the next Socioeconomic Development Plans. The need for environmental experts and managers will increase accordingly. Thus, the future development of the environmental education curricula should address four target groups:

1. generalists, who include policy- and decisionmakers;
2. specialists, in particular, environmental scientists and engineers;
3. technicians, who handle technology transfers; and
4. extension workers from nongovernmental organizations who are in charge of environmental information services.

General strategies to implement the curricula include: (1) training personnel using inter- and multidisciplinary approaches in solving environ-

mental problems; (2) integrating environmental education at local, national and global levels; and (3) promoting individual responsibility to uplift the quality of life and develop awareness in protecting the natural resources. The curricula should address both the positive and negative impacts of socioeconomic development on the environment and natural resources.

Specific strategies include: (1) updating textbooks in ecology and environmental issues; (2) promoting education and research in resources management and environmental technology; and (3) training personnel in environmental quality management.

The overall strategy should be the training of potential leaders with a clear vision of sustainable development of natural resources and the capability to cope with the changing and increasingly complex problems of the environment.

Environmental problems are transboundary in nature. Therefore, regional and international cooperation is necessary to solve some of them. The Institute of Environmental Research at Chulalongkorn University is actively coordinating the United Nations Environment Programme-supported project, the Asia-Pacific Network on Environmental Education for Tertiary Level Institutions. The Faculty of Environment and Resource Studies at Mahidol University, Bangkok, is the headquarters of the Network on Coastal Zone Management.

Marine Science and Environmental Education Training Programs, Department of Marine Science, Chulalongkorn University

The Department of Marine Science, Faculty of Science, Chulalongkorn University was set up in 1968. Two options of marine science studies are provided: Marine Biology and Fisheries, and Physical and Chemical Oceanography. Each year, about 15 students at the second-year level are admitted to the department for a further three-year study. Since 1973, the master's degree program in Marine Biology and in Physical and Chemical Oceanography has been offered. A doctoral program will start in 1991.

The objectives of the department are to:

1. produce qualified graduates in all fields of marine science;
2. strengthen education and training in marine science and related fields;
3. promote and advance knowledge of marine science through information dissemination; and
4. provide guidelines for curricula development and advisory services, on request and when feasible, to other government and private institutions and agencies.

There were 18 professional staff in the department in 1990--10 with specialization in Marine Biology, 4 in Marine Chemistry and 4 in Physical Oceanography.

Although the Department of Marine Science has not yet started a program in CRM, it offers related introductory courses in coastal environmental pollution and management at both undergraduate and graduate levels. Some of these optional courses are:

Marine Biology and Fisheries: Marine Ecology, Fishery Biology, Mangrove Ecology, Fishery Management, Zooplankton Ecology, Aquaculture, Water Pollution Science, Early Life History of Marine Fishes, Coastal Processes and Morphology, Marine Productivity, Estuarine Oceanography and Physioecology of Marine Organisms.

Physical Oceanography: Dynamic Oceanography, Remote Sensing in Oceanography, Meteorological Oceanography, Ocean Waves, Ocean Circulation, Estuarine Oceanography, Dynamics of Sediments and Marine Geochemistry.

Chemical Oceanography: Chemical Oceanography, Laboratory Techniques in Oceanography, Techniques in Aquatic Environmental Studies, Advanced Chemical Oceanography, Marine Chemical Distribution, Marine Chemistry, Marine Organic Geochemistry and Chemistry of Marine Pollution.

Other elective courses are the International Law of the Sea and Aquatic Radioecology Science.

Most of the research work carried out in the university is multidisciplinary in nature, which is favorable in maximizing the capacity of the limited human resources. The current scope of research activities comprises five areas: Oceanography, Environmental Quality with Emphasis on Marine Pollution and its Impacts, Aquaculture, Mangrove Ecology and Coral Reef and Seagrass Bed Ecology.

The department also undertakes interdisciplinary research on the coastal environment and development policy which is financially supported by national and international agencies. According to the Seventh Economic and Social Development Plan (1992-1996), it is also prepared to offer an M.S. degree in Marine Affairs.

On 3-21 December 1990, the department held a three-week intensive training course on Marine Affairs to meet the urgent need of personnel dealing with coastal zone management (CZM). The course was financially supported by the Office of the National Environment Board. There were 14 selected trainees who have at least a bachelor's degree and were from government and private agencies concerned with CZM.

The following topics on Marine Affairs were covered by the staff and invited specialists:

- Marine Affairs: Ocean Development and Management
- Security and Surveillance
- Marine Transportation and Port Development
- Marine Environmental Protection Techniques
- Coastal Planning and Management

Marine Geology Exploration and Management /
Economics of Marine Natural Resources
with Emphasis on Fishery Resources
Fisheries Law and Management
Ocean Business Development with Emphasis
on Ocean Line Business and Seafood
Development of Marine Laws and Regulations

The trainees were divided into two groups which worked on **different case studies**. It is hoped that more workshops of this kind will be **organized by** the department.

The Establishment of a Master of Science Degree and a Diploma Course in Coastal Resources Management: Prince of Songkla University, Thailand

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Abstract

The Coastal Resources Institute (CORIN) was established at Prince of Songkla University (PSU), Thailand, as an interdisciplinary center to spearhead research, policy planning, information campaign, education and training in coastal area management (CAM). All its activities converge towards a common objective--to implement the country's CAM plans for the long term.

The institute's academic program includes a two-year Master of Science and a one-year Diploma course in Coastal Resources Management, complemented with short training courses. This program intends to produce a pool of skilled administrators and decision-makers who will manage and develop the coastal areas. Course requirements and curriculum content are discussed in this paper.

Introduction

PSU was founded in 1967 with the objectives of providing higher education, undertaking research and contributing to the welfare of the people in the Southern Thailand region and the nation as a whole. The only

higher level educational institution in the region, it currently comprises 14 faculties offering 72 undergraduate curricula and 20 graduate programs. Student population is approximately 8,000. The university has three campuses, in Songkla, Pattani and Phuket Provinces, and an affiliated college in Surat Thani Province. One of its main interests is technological advancement for natural resources utilization.

In recognition of the importance of the coastal zone and the need for wise management of coastal resources, PSU established CORIN, an interdisciplinary center where research scientists could work together towards a common goal. Information generated by their collaborative efforts will be used in implementing CAM plans in cooperation with local and national authorities.

CORIN shall address CAM issues through five areas of activities, namely, research, policy planning and implementation, short-term training, public awareness and information dissemination, and education.

A two-year Master of Science and a one-year Diploma Course in Coastal Resources Management, complemented with short training courses, have been established under the direction and authority of CORIN.

Curriculum

M.S. in Coastal Resources Management

This program is open to fresh university graduates who have little or no work experience in the field of science or management. The course consists of 45 credits: 3 core subjects (total of 12), elective subjects (27) and thesis (6).

The core subjects are: Coastal Zone Processes and Ecology (6), Marine Resource Economics (3) and Coastal Resources Management: Policies and Practices (3). The elective subjects could be drawn from available courses offered by several faculties at PSU (Table 1). A minimum of three credits should be taken from each division. Students who prefer specialization must choose at least 12 credits from one of the three divisions. The thesis will be written under the direction of a thesis advisor and a committee, who will be appointed.

Diploma Course in Coastal Resources Management

This program offers an opportunity to those who have considerable coastal resources management-related work experience in government and industry. The diploma course does not require a research-based thesis. Twenty-four credits are necessary: 3 core subjects similar to those of

Table 1. Elective subjects for the M.S. Degree and Diploma Course in Coastal Resources Management, PSU.

Division 1: Basic and Applied Sciences

Marine Biology
 Lake Basin Ecology
 Marine Pollution
 Systems Ecology
 Marine Ecology
 Coral Reef Ecology
 Coastal Ecology
 Mangrove Ecology
 Environmental Research Methodology
 Environmental Information Systems
 Database Management Systems
 Environmental Toxicology
 Pollution Biology
 Coastal Aquaculture
 Appraisal of Water Resources Projects
 Water Pollution and Water Quality Management
 Photogrammetry
 Watershed Management
 Coastal Engineering
 Hydraulic Engineering I and II
 Water Resources Engineering
 Hydrogeography
 Environmental Engineering Design
 Pollution Problems and Control
 Water and Wastewater Analysis
 Fieldwork in Local Geography
 Environmental Impact Evaluation

Division 2: Economics and Management

Business Forecasting
 Marine Insurance
 Transportation Economics
 Economic Analysis of the Environment
 Economic Development Sciences
 Economics of Natural Resources
 Socioeconomic and Political Aspects
 of Environmental Management
 Economics of Fishery Resources
 Fishery Economics
 Economics of Land Resources
 Economics of Forest Resources
 Aquaculture Economics
 Travel and Tourism Industry Management
 Management Techniques
 Development Planning
 Environmental Project Management
 Principles of Project Analysis
 Project Management
 Local Government and Minority Groups
 Human Relations in Environmental Management
 Administration in Environmental Conservation

Continued

Table 1 (continued)

Community Systems Development
 Project Analysis and Evaluation
 Population and Environmental Policy
 System Approaches to Environmental Management
 Freshwater Resources Management
 Coastal Resources Management
 Land Resource Development
 Coastal Conservation
 Locational Planning
 Rural Land Use Planning
 Marine Affairs
 Aquatic Resources Management
 Fishery Economics
 Water Transportation
 Land Use and Urban Planning
 Transportation Systems Planning
 Mine Environmental Planning
 Land Use Planning
 Soil Resources Evaluation
 Watershed Management
 Principles of Land Use
 Environmental Impact Evaluation
 Solid and Hazardous Waste Management

Division 3: Public Awareness and Education

Communication and Public Relations
 Environmental Techniques
 Educational Planning
 Comparative Educational Administration
 Organization and Administration of Nonformal Education
 Human Ecology and Public Health
 Development of Local Occupation
 Environmental Health

the masteral program (12), elective subjects (9) and a major paper (3). Students are advised to choose their electives from one division. The major paper, based on the student's topic of interest, will be written under the direction of an academic advisor and submitted at the end of the second semester.

Education and Training in Coastal Area Management: A Survey of the United States Experience

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Abstract

This paper surveys educational and training opportunities in coastal area management (CAM) with emphasis on graduate programs in North America. Examples of the types of educational programs, curricula and institutional arrangements are presented. It is proposed that the supply, demand and needs for a CAM program be assessed. Comparisons are made between demand for the United States (US) and developing country programs. Finally, suggestions for developing Association of Southeast Asian Nations (ASEAN)-based CAM education and training programs are given.

Introduction

CAM is a human endeavor. We do not manage resources so much as manage people who live in, visit and derive their livelihoods from the use of the resources and space in the coastal zone. The institutions, laws and regulations, and physical structures we develop for the coastal zone are all designed to guide and modify human behavior to either maximize benefits to mankind, protect lives and preserve livelihoods, or to protect the resources from the consequences of human activity and mitigate

resulting impacts. This human element is often taken for granted but is the major driving force behind all of our management efforts.

CAM is a new and rapidly growing field with less than two decades of experience in the US. In developing countries, its history is even shorter. However, there is a growing worldwide body of principles and techniques, training and education programs in CAM. For nations with CAM programs or projects, this represents a rich source of experience from which to learn.

CAM deals with some of the most dynamic and complex ecosystems, requires coordination among several government agencies with overlapping and conflicting jurisdictions and involves numerous user and interest groups.

The capabilities of coastal managers are acquired on the job or through special training or traditional degree programs. The professional skills of the staff are of critical importance for any CAM program to succeed; their improvement must thus be given high priority.

Degree Programs

At present, only the University of Newcastle upon Tyne (UNT) in the United Kingdom (UK) offers an actual degree in Coastal Management with emphasis on tropical environments. Similar programs are notably absent in developing countries, but two programs are being proposed in Thailand, and others will most likely soon emerge.

However, more than a dozen programs, primarily in the US, offer specializations relevant to CAM and are linked to Marine Affairs or Oceanography programs (Table 1). The majority are at the master's level, although there is a doctoral program in Marine Affairs at the University of Delaware. The institutional arrangements for the degree programs fall under two categories: as specializations within existing degree programs such as Oceanography or Environmental Science, or as separate Marine Affairs or Coastal Management programs. The master's programs cover a range of possibilities, from art- to science-based degrees.

West (1986) provided a useful framework for Marine Affairs programs, classifying them into three basic curriculum clusters: physical/natural sciences, management, and law and policy. This classification works well for all degree programs with CAM specializations. Not all students in marine affairs programs specialize in CAM. Specializations offered within Marine Affairs also include Ports and Maritime Transportation, Fisheries Management and Marine Law. There are, however, significant overlaps in curriculum content between CAM and other specializations, and between Marine Affairs and other programs, such as Oceanography and Environmental Sciences, which offer specializations in CAM. All these programs are interdisciplinary in nature, and their required courses are frequently multidepartmental (Tables 2 to 8). Many of the programs require an

Table 1. Selected institutions with existing and proposed CAM-related graduate programs.

Institution	Degree
US	
University of Rhode Island (URI)	Ph.D. in Marine Affairs (proposed) M.M.A. (Master in Marine Affairs) M.A.M.A. (Master of Arts in Marine Affairs) B.A. in Marine Affairs
Florida Institute of Technology (FIT)	M.S. in Oceanography (Coastal Zone Management Specialization)
University of Massachusetts (UM)	Ph.D. in Environmental Sciences
University of Washington (UW)	M.M.A. (Master in Marine Affairs) LL.M. Law and Marine Affairs
Oregon State University	M.A. or M.S. in Marine Resources Management
Texas A & M University	M.S. in Management (Marine Resources Management Specialization) M.B.A. (Marine Resources Management Specialization) M.P.A. (Marine Resources Policy and Administration Specialization)
UK	
University of New Castle upon Tyne (UNT)	M.S. in Tropical Coastal Management
Thailand	
Chulalongkorn University	M.S. in Marine Affairs (proposed)
Prince of Songkla University (PSU)	M.S. in Coastal Resources Management (proposed)
Canada	
Dalhousie University	Graduate Diploma in Marine Affairs Master in Marine Affairs (proposed)
University of Quebec at Rimouski	Graduate Diploma in Marine Affairs Master in Marine Affairs (proposed)

Table 2. M.S. in Oceanography (Coastal Zone Management Specialization), FIT.

Required courses (39 credits)	Representative elective courses (9 credits)
Engineering Planning and Economic Analysis	Coastal and Estuarine Processes
Urban Planning	Principles of Geological Oceanography
Introduction to Water Resources	Remote Sensing
Graduate Oceanography Seminar	Sea Laboratory Techniques
Principles of Chemical Oceanography	Population Ecology
Principles of Bio-environmental Oceanography	Site Planning and Engineering
Principles of Physical Oceanography	Introduction to Air Pollution
Coastal Systems Planning	Techniques of Environmental Health
Legal-Environmental Relationships	Introduction to Water Quality
Internship or Thesis Research	Development of Environmental Impact Statements
Behavioral Sciences and Management	
Urban Planning and City Administration	

Table 3. A selection of required courses (40 credits with 15 from the School of Law) for LL.M. Law and Marine Affairs, UW.

Law	Marine Studies
Law of the Coastal Zone	Marine Affairs
Admiralty	Ocean System
Law and Social Science Methods	Marine Sciences and Uses of the Ocean
Law, Public Land and Environment	Marine Uses and Resources:
International Legal Organization	Living Resources
International Legal Order	International Organizations and
International Law of the Sea	Ocean Management
Ocean Policy and Resources Seminar	Economic Aspects of Marine Policy
US Law for Living Marine Resources	Ocean Environment and Living Resources
Civil Engineering	Marine Uses: Transportation and Commerce
Marine Technology Affairs I	Ocean Law Enforcement
Marine Technology Affairs II	Regional Implementation of an
	Extended Economic Zone
Program in Ocean Engineering	Special Topics in Marine Studies
Ocean Engineering Systems Design I	Advanced Coastal Management Seminar I
Ocean Engineering Systems Design II	Advanced Coastal Management Seminar II
	Marine Resources Management Seminar I
Graduate School of Public Affairs	Marine Resources Management Seminar II
Policy Development and Administration:	Independent Study or Research
Natural Resources	
Policy Development and Administration	Program in Social Management of Technology
	Social Management of Technology I:
	Natural Resources

Table 4. Required courses (69 credits from the following courses plus 9 credits for thesis) for M.M.A., UW.

Undergraduate Research
Marine Affairs
Ocean System
Marine Sciences and Uses of the Ocean
Marine Uses and Resources: Living Resources
International Law of the Sea
International Organizations and Ocean Management
Economic Aspects of Marine Policy I, II
Principles of Coastal Zone Management
Law of the Coastal Zone
Coastal Zone Management: Applying Environmental Information
Ocean Environment and Living Resources
Marine Uses: Transportation and Commerce
Ocean Law Enforcement
Regional Implementation of Extended Economic Zones
Special Topics in Marine Studies
Ocean Engineering Systems Design I,II
Ocean Policy Seminar
Advanced Coastal Management Seminar
Research Seminar in Marine Resources Management
Independent Study or Research

Table 5. Required and elective courses for M.M.A. and M.A.M.A., URI.

M.M.A. (18 credits)

Ocean Uses and Marine Science
 Marine Geography
 International Ocean Law
 Marine Affairs Seminar I
 Marine Affairs Seminar II
 Economics of Marine Resources

M.A.M.A. (24 credits plus 6 credits for thesis)

Quantitative Methods in Geography and Marine Affairs
 Research Methods in Geography and Marine Affairs
 Ocean Uses and Marine Science
 Marine Geography
 International Ocean Law
 Marine Affairs Seminar I
 Marine Affairs Seminar II
 Economics of Marine Resources

Representative elective courses: M.M.A. (12 credits) and M.A.M.A. (15 credits)

Marine Affairs

Peoples of the Sea
 Polar Resources and Policy
 Coastal Zone Uses
 Island Systems
 Marine Recreation Management
 Ocean Uses and Marine Science
 Seminar on Marine Science Policy and Public Law
 Seminar on Urban Waterfront
 Seminar on Coastal Margin Management
 Coastal Zone Law
 Fisheries Law and Management
 Fisheries in Developing Countries
 International Coastal Zone Issues
 Admiralty Law
 Maritime Transportation
 Port Operations and Policy
 Marine Geography
 Management of Ocean Regions
 International Ocean Law
 International Ocean Organizations
 Marine Jurisdictional Issues
 Environmental Impact Assessment and Analysis

Resource Economics

Economics of Natural Resource Use
 Aquaculture Economics
 Benefit-Cost Analysis
 Economics of Ocean Management
 Economics of Marine Resources
 Economics of Natural Resources

Fisheries and Marine Technology

Fishery Science
 Industrial Fishery Technology
 Marine Fisheries Ecology
 Marine Fisheries Technology
 Fishing Gear Technology
 Special Problems

Table 6. Required courses for B.A. in Marine Affairs (30 credits), URI.

Marine Affairs

Human Use and Control of the Marine Environment
 Maritime New England
 Quantitative Methods in Geography and Marine Affairs
 Problems in Marine Affairs
 Introduction to Marine and Coastal Law or Introductory Cartography

Five of the following courses

Politics of the Ocean
 Marine Pollution Policy
 Maritime Transportation and Ports
 World Fishing
 Peoples of the Sea
 Polar Resources and Policy
 Coastal Zone Uses
 Island Systems
 Marine Recreation Management
 Directed Study in Marine Affairs

Required courses in Resource Economics and Oceanography (6 credits)

Introduction to Resource Economics
 General Oceanography

Table 7. Ph.D. in Environmental Sciences (with emphasis on Water Quality, Urban Harbors and Coastlines), UM.

Core courses (17 credits)

Applied Statistics
 Scientific Writing
 Chemistry of Natural Waters
 Biological Oceanographic Processes
 Physical Oceanography or Estuarine Oceanography
 Environmental Policy and Administration
 Scientific Information and the Policy Process
 Coastal Zone Management
 Urban Harbor Management

Representative elective courses (24-30 credits)

Graduate Courses in Environmental Sciences
 Behavior and Ecology of Sea Birds
 Special Topics in Environmental Sciences
 Research Methods in Environmental Sciences
 Applied Programming in Environmental Sciences
 Principles of Qualitative Modelling in Biology
 Independent Studies in Environmental Sciences
 Chemical and Biological Problems in Urban Estuaries

Graduate Courses in the College of Management

Organizational Theory and Behavior
 Operations Management
 Computer and Information Systems

Continued

Table 7. (continued)

Graduate Courses in Dispute Resolution
Negotiation
Mediation
Theories of Conflict and Resolution
Advanced Negotiation and Mediation
Courses available at neighboring institutions
Environmental Law
Urban Planning and Design
Case Studies in Occupational and Environmental Health
International and Environmental Policy and Development

Table 8. Required courses for the one-year M.S. in Tropical Coastal Management, UNT. (N. Polunin, pers. comm.)

Terms 1 and 2
Coastal Ecosystems Ecology
Wastewater Management
Eco-toxicology
Fisheries Management
Habitat Management and Valuation
Economics of Resources Management
Physical Processes
Coastal Oceanography
Environmental Impact Assessment
Remote Sensing
Term 3
Research Project

internship in lieu of a thesis and have a marine rather than a coastal orientation.

Assessing Supply, Demand and Needs

The US educational programs were an outgrowth of the environmental movement which started in the late 1960s and early 1970s, as well as from legislative mandates such as the US Coastal Zone Management Act, the Clean Air and Water Acts, the Fisheries Management and Conservation Act, and the International Law of the Sea negotiations. This setting essentially created the demand for trained coastal and marine managers. The more recent development of the UK and Canadian programs, which were designed specifically with developing countries in mind, and the relatively large percentage of international students in the US-based Marine Affairs programs, indicate a growing demand in developing countries for trained coastal and marine managers. If this is the case, then it seems logical to assume that these countries need to consider developing their own indigenous programs which cater to local issues and needs.

Table 11. Professional/technical staffing of the Sri Lanka Coast Conservation Department (CCD).

Position	No.	Duties and responsibilities	Background/experience
Director	1	Overall supervision and management of CCD	Engineer
Planning Division			
Manager	1	Formulation and implementation of the Sri Lanka CZM	Planners/biologists
Deputy Manager	3	Plan; review, processing and enforcement of permit applications	
Assistant Manager	2		
Planning Officers	2		
Engineering Division			
Planning, Investigation and Design	3	Planning and construction of shoreline protection works	Engineers
Master Plan Implementing Group	4		
Regulation Implementing Group	9		
Works	7		
Total	32		

implement the program (Chaverri 1989; Sorensen 1990). Ecuador also has two full-time government personnel assigned to its CZMP. However, there are about a dozen full-time employees supported under the United States Agency for International Development (USAID) Coastal Resources Management Project (CRMP).

In all of the above cases, no more than a third of the professional staffing could be considered likely candidates for a postgraduate degree program. It is uncertain whether developing countries have sufficient demand to absorb five to ten CAM graduates per year to justify a national postgraduate degree program. These countries have relatively small populations and coastal areas compared with the US and some of the larger countries in Southeast Asia, i.e., Indonesia, Thailand and the Philippines. From geographic and demographic perspectives, the ASEAN region could have a similar potential demand for CAM degree programs as that of the US.

Institutional and Program Development

After the demand and the needs for a degree program are assessed, the next task is to determine where and how such a program can be developed. In this regard, the following issues need to be addressed:

- the appropriate institutional arrangement that can best fit within the existing university structure (e.g., a separate department or an interdepartmental program);
- the right mix of faculty in the natural and social sciences;

- an evaluation of how to build on the strengths of existing programs within the institution (physical/natural science orientation versus a law/policy/management program orientation);
- faculty and institutional development needs to support the program;
- a determination of curriculum content, job task analysis and institutional and faculty capability; and
- the entry requirements of program applicants (e.g., natural or social science background; a few years' work experience, or none).

The development of an educational program is a long-term strategy to meet a nation's manpower needs. Attention must be given to program planning and institutional capacity to develop a CAM degree program. The capabilities of different universities to build multidisciplinary programs, as well as the faculty's educational attainment, vary considerably (Table 12). In URI, faculty members without doctorates comprise a small minority. URI offers 34 doctorate programs, 18 Master of Arts, 43 Master of Science and 7 postgraduate professional degree programs.

Table 12. A percentage comparison of educational attainment of faculty in CAM-related departments of three universities.

Educational attainment	Escuela Superior Politécnica del Litoral (ESPOL) (Ecuador)	PSU (Thailand)	URI (US)
Doctorate	3.7	37.7	95.6
Master's	51.0	61.0	4.4
Bachelor's, Engineering, Licenciado and other nonmaster's professional degrees	35.8	1.3	0
Technical	9.5	0	0
	N=190	N=77	N=159

One of the best universities in Ecuador with CAM-related programs, ESPOL offers only one professional postgraduate degree program. This is not surprising given that only a handful of faculty hold doctorate degrees and a little more than half of them have master's and doctorates. Since ESPOL programs emphasize natural and technical sciences, there are only a few social science faculty. No degree program in CAM has been proposed at ESPOL due to insufficient national demand and capable faculty. If Ecuador is to develop a truly interdisciplinary CAM postgraduate program that combines the natural and social sciences, an inter-institutional arrangement may have to be considered.

PSU in Thailand has a high percentage of faculty with postgraduate degrees, considerably more than that of ESPOL at the doctorate level, but less than that of URI. PSU also has a broad diversity of programs in the social and natural sciences. Given the university's capacity and the country's demand for trained coastal managers, a master's program in

CAM is now being planned. The PSU case is probably reflective of those of several universities in the ASEAN region which could develop degree programs in CAM.

Faculty competence and expertise can be further developed through participation in short-term training programs, obtaining degrees with CAM specializations or gaining experience. The last one involves engaging in national CAM program and project activities; providing technical assistance to local and national governments in the formulation and implementation of management plans; conducting applied research and policy analysis; and implementing extension and public education programs. The ASEAN/US CRMP plays a significant role in carrying out these activities and helps many universities develop their CAM programs. The institutional strengthening strategy at PSU has also made practical experience a key feature of the program.

Training Courses

Numerous short courses in CAM have been offered over the last couple of years in many countries. Unfortunately, very few courses are offered on a regular, annual basis. Most are designed for a specific country or region as part of a project undertaken only once.

This survey found four short courses on CAM that have been or will be offered in the US (Table 13). Three of these target developing country participants. The challenge to holding US-based short courses is designing a curriculum relevant to participants from various nations, agencies and backgrounds. These courses are relatively expensive, averaging about US\$900 per week, excluding airfare to and from the training venue. Funding is a major factor in determining the success and regularity of the courses. The sponsorship by an international development project or institution is needed, as few developing country host institutions can justify the cost of such training courses.

Table 13. US-based short courses on CAM.

Course title	Venue	Sponsor	Duration (weeks)	Frequency of offering
International Seminar on Coastal Parks and Protected Areas	Florida and Costa Rica Florida and Mexico	National Parks Service University of Miami	3-4	Annually or biannually 1989 and 1991
Coastal Policy and Processes	South Carolina and Costa Rica	University of South Carolina	4	Offered once in 1989
CZM General Principles and Current Issues	Florida	Nova University	1	Offered once in 1989
Summer Institute on Coastal Management	Rhode Island	URI	4	New program starting in 1991 (expected to be offered annually)

The 1990s is often talked about as the decade of the environment and natural resources. International development agencies and lending institutions are increasing their program emphasis in these areas. The USAID policy is to allocate about 25% of the funds for such training activities. Therefore, there is a high likelihood that programs in these fields will not face funding constraints in the future.

Three courses, Coastal Policy and Processes, CZM General Principles and Current Issues, and the Summer Institute in Coastal Management, provide a basic understanding of the tools and techniques of CAM. The International Seminar on Coastal Parks and Protected Areas is a more focused, conservation-oriented program; it is the only one so far to be offered more than once. The Coastal Parks and Coastal Policy courses have split the training venue between the US and a developing country in the Caribbean and Central American region. This is to make the program more applicable to developing country participants and to blend the best of lessons and experience from the US and developing countries.

The Summer Institute strategy aims to implement the program initially in the US and then in the region through a host institution. This will allow the curriculum to evolve over time, through revision and adaptation to regional needs and issues. The strategy also attempts to build regional capacity to conduct short-term training programs. Sustainable development in CAM ultimately means having not only national programs, but also regular education and training programs in the institutions in the region designed to meet local needs.

Recommendations and Conclusion

The US education and training programs in CAM are models after which programs for the ASEAN region can be designed. However, there is no one model which may be considered best or necessarily appropriate for the region.

Compared with the other regions, the ASEAN region is fortunate to have many highly capable marine and coastal scientists, and excellent university programs. These factors, in addition to the high level of CAM project experience, provide a solid foundation on which to build indigenous education and training programs. Such programs are starting to emerge. In the United States, various programs have been established based on specific institutional strengths which meet a diversity of needs. Diversity may also be an appropriate strategy in developing the programs in the ASEAN region..

It is recommended that the region's postgraduate program accept students from different backgrounds, particularly those with years of practical experience. Requirements may include an internship and a basic knowledge of natural and physical sciences. The curriculum should be

flexible enough to meet a student's specific needs based on his experience and undergraduate degree training. This requires an interdisciplinary, integrated approach which aims to develop generalists. Emphasis should be on developing management skills.

The curriculum should focus on critical management issues in the region which include:

- water quality management;
- habitat regulation, protection and restoration, with emphasis on coral reefs and mangroves;
- human and natural hazards, including typhoons, tsunamis, oil spills, erosion and sea level change;
- policy and market failures and reforms required to properly manage coastal resources and environments;
- policy, management and regulatory tools and techniques;
- the role of public education and participation; and
- balance of local versus national authority and priorities.

Unlike most of the US programs, a coastal rather than a marine orientation must be emphasized. This includes a significant land-based requirement to the curriculum including water resources and watershed management, land use and urban and regional planning. Finally, the programs should be developed along the lines of agricultural ones, where there is a strong linkage between the curriculum and applied research, with extension projects. The faculty must have experience in CAM issues and program planning and implementation. An interchange of faculty and government officials is suggested so the practical experience of practitioners can be integrated into the educational program and transferred to the next generation of coastal area managers.

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Part II: Workshop Report

A Proposed Postgraduate Coastal Area Management Curriculum for Southeast Asia

Rationale

The Baguio Resolution on Coastal Resources Management (formulated at the Policy Conference on Managing ASEAN's Coastal Resources for Sustainable Development held on 4-7 March 1990 in Manila and Baguio City, Philippines) recognized that coastal areas must be managed for sustainable development to maintain and enhance the livelihood of coastal communities amid population and economic pressures especially in tropical countries. Effective CAM can best be achieved through the development and implementation of integrated programs. To do this, the management capabilities of governmental and nongovernmental organizations responsible for CAM need to be strengthened. The public needs to be made aware, too, of its critical dependence on the continued productivity of coastal resources through nonformal education.

Professional and technical support staff of organizations must be given appropriate formal education and training in CAM--dealing with issues and problems, and developing effective strategies, among others. Their capability must be further enhanced based on knowledge of the coastal resources and the environmental, social, cultural and economic systems; and understanding of present and future environmental problems and their solutions through an integrated management approach.

Trained manpower in integrated CZM is not adequately provided at present by educational institutions in the region. The master's program discussed below is intended to address the need to develop educational programs in this line.

While the consensus among the participants was that both formal and nonformal education in CAM are important, the discussions, however, were restricted to the formal component, that is, at the master's degree level. Thus, the principal clientele of CAM education will be the coastal area planners and managers in government agencies in the ASEAN region.

Purpose and Duration

The CAM curriculum is composed of three types of courses--core courses with theoretical and/or methodological focus, case studies and a student project. The purpose of the first type is to give students a sound foundation in the principles and methodologies for CAM across the relevant disciplines.

The case studies aim to illustrate successful CAM approaches that have been implemented in the region. They should have two basic themes: how the topics of various core courses are utilized in integrated management programs; and how selected CAM problems can be addressed. The manner and form in which the case studies would be presented are extremely important. They should elicit considerable discussion and debate among class members, and move them to draw upon the body of interdisciplinary knowledge gained from the core courses. Ideally, the case studies should require problem-solving and conflict resolution.

The program's objective is to give students exposure to real world CAM issues and to provide them with an opportunity to independently practise skills acquired from the core courses and case studies.

The curriculum will be for a period of one academic year, consisting of 42 instructional weeks, with three terms of 14 weeks each. The unit system will be employed, as this is the most widely used in the region. Courses will be 3 units each, unless otherwise specified. Each unit will consist of one lecture/week for 14 weeks or one 3-hour laboratory work/week for 14 weeks.

Unique Characteristics

The curriculum focuses on issues of regional relevance. It covers the basic principles of tropical CAM with emphasis on regional and developing country examples. In this way, educational institutions can adopt the curriculum on a national or regional basis. If the program will be offered on a regional basis, a three- to six-month pretraining in English proficiency may be required for some students.

Proposed Curriculum and Course Content

First term

- A. Coastal oceanography and coastal processes:
 - 1. Oceanography
 - a. Physical
 - b. Chemical
 - c. Geological
 - d. Biological

2. Hydrology and climatology
 - a. Saltwater intrusion
 - b. Coastal climate and climate change
 3. Coastal processes
 - a. Erosion
 - b. Sediment transport and deposition
 4. Coastal engineering
 - a. Land reclamation
 - b. Coastal structures
- B. Tropical coastal pollution
1. Types of pollution and their impact on coastal ecosystems
 2. Sources of pollutants - point and nonpoint, domestic, industrial, agricultural
 3. Types and fates of pollutants
 4. Waste treatment and disposal
 5. Biological effects
 6. Environmental health problems
 7. Environmental carrying capacity
- C. Coastal ecosystems: structure and function
1. Ecological principles
 - a. Food chains and food webs
 - b. Dynamic processes and linkages between ecosystems (land-sea continuum)
 2. Critical ecosystems and habitats
 - a. Ecosystems
 - 1) Bay
 - 2) Lagoon
 - 3) Gulf
 - 4) Estuary
 - 5) River basin
 - b. Habitats
 - 1) Coastal forest
 - 2) Mangrove
 - 3) Coral reef
 - 4) Seagrass
 - 5) Intertidal zone
 3. Interdependencies among critical ecosystems and habitats
 4. Vulnerability of ecosystems
- D. Coastal resources and management
1. Distribution and abundance
 - a. Nonliving resources: land, water and minerals
 - b. Living resources: fisheries, coral, mangrove, wildlife, etc.
 - c. Resource assessment
 2. Management aspects of coastal resources
 - a. Management concepts
 - b. Utilization

- c. Conservation of genetic resources
 - d. Conservation of species and habitats
- E. Economics of coastal resources and activities
 - 1. Introduction
 - a. Concepts of scarcity
 - b. Opportunity cost
 - c. Comparative advantage
 - 2. Resource economics
 - a. Renewable resources
 - b. Nonrenewable resources
 - c. Excludability
 - 3. Economic valuation techniques
 - a. Market-based techniques
 - b. Surrogate-market techniques
 - c. Survey-based techniques
 - 4. Major economic activities in coastal areas
 - a. Tourism
 - b. Fisheries/aquaculture
 - c. Transport
 - d. Industry
 - e. Forestry
 - f. Mining

Second term

- F. Social aspects of coastal development
 - 1. Coastal development economics
 - a. Demography: population structure/growth, income distribution/poverty, health and education
 - b. Other factors influencing/constraining structural changes
 - c. Sustainable development
 - 2. Anthropology
 - a. Traditional activities/cultural values
 - b. Community participation
- G. Institutional arrangements for coastal management
 - 1. Administrative structure, including government organization, functions and jurisdiction
 - 2. Permit system, including application and requirements, monitoring and control
 - 3. Zoning laws/land use
 - 4. Law enforcement agencies and functions, implementing procedures
 - 5. Nongovernmental organizations
 - 6. International agencies
 - 7. Environmental laws (national and local)
 - a. Pollution - disposal of domestic and industrial wastes, oil spills, pesticides

- b. Preservation and conservation
 - c. Deforestation; biodiversity including marine parks and critical habitats, endangered species, introduction of exotic fishes, coral and mangrove resources
- 8. Dispute settlement
 - a. Extralegal remedies - negotiation, mediation and conciliation
 - b. Administrative procedure, authority and governance
 - c. Court procedures
 - d. Prosecution
 - e. Evidence
 - f. Execution of judgment
- H. Remote sensing and GIS
 - 1. Principles of remote sensing
 - a. Aerial photo interpretation
 - b. Satellite imagery, e.g., Landsat and SPOT
 - c. Software and hardware, e.g., Earth Resources Data Analysis System (ERDAS), MICROBRIAN
 - 2. Principles of GIS
 - a. Data structures : raster vs. vector-based data
 - b. Data collection and standardization
 - c. Analysis and modelling
 - d. Software and hardware, e.g., ARC/INFO, Spatial Analysis System (SPANS)
 - 3. Applications of remote sensing and GIS for CAM
- I. Resource surveys and environmental information system (EIS)
 - 1. Baseline studies
 - 2. Survey methodologies
 - 3. Analysis of results
 - 4. Data and databases; information retrieval systems
 - 5. Application of EIS
 - 6. Project management evaluation
- J. Coastal area planning and management
 - 1. Coastal area planning process
 - 2. Land use planning
 - 3. Profiling
 - 4. EIA
 - 5. Management plans
 - 6. Development control and regulatory techniques
 - 7. Environmental quality standards
 - 8. Public participation
 - 9. Monitoring and evaluation
 - 10. Public awareness and education
 - 11. Enforcement and compliance
 - 12. Special area management
 - a. Marine parks and protected area management
 - b. Management of critical habitats

- c. Tourism area development and management
- d. Island management

Third term

- K. Analysis of coastal development alternatives
 - 1. Political economy
 - a. Analysis of effects of given/existing institutional setting
 - b. Beneficiaries and nonbeneficiaries
 - c. Possible changes
 - 2. Policy analysis
 - a. Analysis of effects of given/existing policies
 - 3. Coastal project analysis
 - a. Extended benefit/cost analysis
 - b. Cost-effectiveness analysis
- L. Marine legal regime
 - 1. Property and tenure rights
 - 2. Territorial waters
 - 3. Boundaries
 - 4. Fisheries law
 - 5. International law (Law of the Sea)
 - 6. Transnational activities
 - a. Shipping and transportation, including traffic; chemical, solid and toxic wastes
 - b. Offshore mining (oil, petroleum, metals)
 - c. Fishing
- M. Case studies in tropical CAM
 - 1. CAM plans in ASEAN
 - 2. Regional planning of the Eastern Seaboard of the Gulf of Thailand
 - 3. Logging, fisheries and tourism in Palawan, Philippines
 - 4. Trawling and traditional fishing
 - 5. Aquaculture and mangroves
 - 6. Land reclamation in the West Coast of Peninsular Malaysia
 - 7. Coastal erosion and control in Java
 - 8. Water quality management in Prai Industrial Estate, Penang, Malaysia
 - 9. Singapore River cleanup
 - 10. Municipal marine reserves in the Philippines
 - 11. Mine tailings in the Philippines
 - 12. Planning and management along urban coastal areas
- N. Project work

Note: Each subject is 3 units (except the 6-unit project work) for a total of 45 units.

Appendices

List of Participants

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Ms. Maylene Loo
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Secretariat

Ms. Cory C. Guerrero
ICLARM

Workshop Program

Monday, 8 October
A.M.

Brief background of the workshop and introduction of participants by Dr. Chua Thia-Eng.

Chairperson: Dr. Chia Lin Sten

Rapporteur: Dr. Ir. Sahala Hutabarat

Presentation of papers: evaluation of existing educational programs related to marine and coastal environments in the ASEAN region, with special reference to planning and management

Brunei Darussalam: *Dy. Dulima Jali* and *Dr. Sattish Choy*, Universiti Brunei Darussalam

Indonesia: *Dr. Ir. Sahala Hutabarat*, Diponegoro University

Malaysia: *Dr. Zetina Zaiton Ibrahim*, Universiti Pertanian Malaysia

Philippines: *Dr. Edgardo Gomez* and *Prof. Myrna Feliciano*, University of the Philippines

P.M.

Chairperson: Dr. Twesukdi Piyakarnchana

Rapporteur: Dr. Zetina Zaiton Ibrahim

Presentation of papers

Singapore: *Dr. Chou Loke Ming* and *Dr. Chia Lin Sten*, National University of Singapore

Thailand: *Dr. Twesukdi Piyakarnchana*, Chulalongkorn University

United States: *Mr. Brian Crawford*, University of Rhode Island

Tuesday, 9 October
A.M.

Chairperson: Dr. Edgardo Gomez

Rapporteur: Dr. Leong Yueh Kwong

Presentation of papers

Indonesia: *Dr. Ismudi Muchsin*, Bogor Agricultural University

Malaysia: *Dr. Leong Yueh Kwong*, Universiti Sains Malaysia

Thailand: *Dr. Somsak Boromthanarat*, Prince of Songkla University

Open discussion: guidelines for incorporating coastal area planning and management as new study areas in programs in higher educational institutions in the ASEAN region

P.M.

Continuation of discussion

Wednesday, 10 October

Chairperson: Dr. Edgardo Gomez

Rapporteur: Dr. Satish Choy

Open discussion: a regional graduate (master's level) program on coastal area planning and management

Thursday, 11 October

Chairperson: Dr. Edgardo Gomez

Rapporteur: Prof. Myrna Feliciano

Open discussion: teaching materials